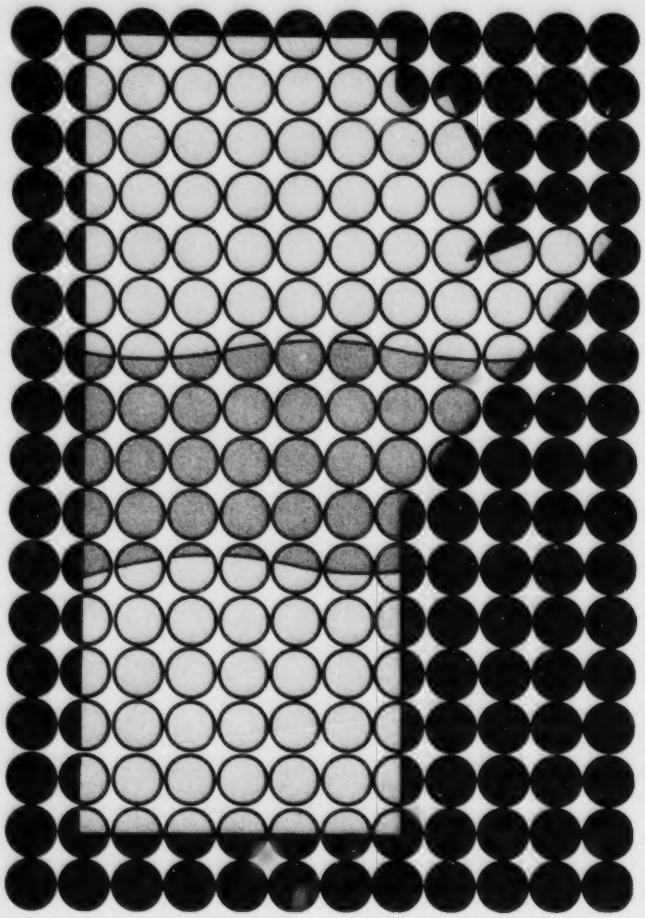

CANADA — MANITOBA
Soil Survey

Soils of the Rural Municipalities of Grey, Dufferin, Roland, Thompson and part of Stanley

Report D60

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SOILS REPORT No. D60 1988

SOILS OF THE RURAL MUNICIPALITIES OF GREY, DUFFERIN, ROLAND, THOMPSON AND PART OF STANLEY

by

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CANADA MANITOBA SOIL SURVEY

CANADA DEPARTMENT OF AGRICULTURE

MANITOBA DEPARTMENT OF AGRICULTURE

DEPARTMENT OF SOIL SCIENCE, UNIVERSITY OF MANITOBA

HOW TO USE THIS SOIL SURVEY

This report contains information on the soils of the study area, their origin, formation, classification and potential for dry land agriculture, irrigation, engineering and recreational land uses.

The report is divided into four parts: Part 1 provides a general description of the area; Part 2 describes the general nature of the survey area and the factors affecting soil formation. Part 3 discusses the development, scientific classification, and morphological characteristics of the soils; Part 4 provides an interpretation of soil properties and associated landscape features as they affect soil capability or suitability for various land uses.

The accompanying soil maps are presented at two different scales. Detailed soils information is presented for the area below the Escarpment on a 1:20,000 aerial photo base to assist the user in locating the soil areas in relation to physical features such as roads, field boundaries and building sites. The soil information for the area above the Escarpment is presented on a line map at a scale of 1:50,000. The following steps are suggested in using the report.

1. Locate the area of interest in terms of the quarter section (NW,NE,SW or SE), section (1 to 36), township (1 to 9), range (3 to 7). eg. NE 1/4-32-6-4W.

2. Consult the index to map sheets, to locate the appropriate map sheet number. eg. map #3.

3. Consult the appropriate soil map and locate the area(s) of interest on the map and identify pertinent map unit symbols (eg. NBG, PGK). Arabic numerals placed as subscripts following map symbols indicate approximate proportions of each soil type within the map unit.

4. Locate the desired map unit symbols in the map legend (Appendix F). Symbols are listed alphabetically giving the soil name, surface texture, soil drainage, mode of origin, soil material, and subgroup.

5. For further information, consult the appropriate sections in the soil report. General description of individual soils are found in Part 3; interpretive information is in Part 4.

ACKNOWLEDGEMENTS

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The soils were mapped by C. Aglugub, Wm. Gardiner, D. Holmstrom, L. Hopkins, W. Michalyna, G.P. Podolsky, I.G Podolsky, E. St. Jacques and D. Swidinsky.

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D. Sandberg, typed and assisted in the preparation of the report.

PREFACE

This report and accompanying map provide a detailed inventory of the soil resources of the Rural Municipalities of Grey, Dufferin, Roland, Thompson and the western portion of Stanley municipality. It is one in a new series of such reports providing a more detailed comprehensive soil survey to complement and expand on information contained in the reconnaissance surveys for southern Manitoba. New mapping techniques, more intensive field investigations, use of aerial photographs and topographic maps combined with improved methods of studying soils in the laboratory and accumulated knowledge of the properties and uses of soils over the years have all contributed to the increased information provided in these reports.

Information in this report is presented in both a descriptive form for users who wish to derive their own interpretations and also in an interpretive form to assist other users who require some initial assessment of soil behavior under different management systems. Descriptive information is provided for all soils that occur in the project area, as well as interpretations for land uses related to agriculture, irrigation farming, engineering and outdoor recreation.

Soil map information is provided at both the detailed scale of 1:20,000 on an aerial photomosaic base and the less detailed scale of 1:50,000 on a planimeteric line map base. The detailed soil maps cover the level lacustrine areas below the Manitoba Escarpment where more intensive agricultural use and growing competition for other uses of land has a need for more detailed soil information. The less detailed maps cover areas above the Manitoba Escarpment where agricultural use and competition for nonagricultural uses is less intense.

During the course of this resurvey a large volume of site specific soil data was gathered that for practical reasons cannot be included in this report. These data have been input into the Canada Soil Information System (CanSIS). This computerized system of soil resource data management permits automated manipulation and statistical evaluation for both map and soil characterization and interpretation. Thematic interpretive maps showing general agricultural land capability or single feature maps showing various soil properties or landscape features as texture, drainage class, slope, etc., can be derived from the basic soil maps and other data files in CanSIS. Individual requests for such data should be directed to: Canada-Manitoba Soil Survey, Department of Soil Science, Rm. 362, Ellis Bldg., University of Manitoba, Winnipeg, Manitoba R3T 2N2.

The staff of the Canada-Manitoba Soil Survey trust that this report and accompanying maps will be of value, in terms of providing a basic inventory of the properties of soils, to all who may be involved in the planning, development and management of the soils in this project area.

How this Survey was Made

Soil mapping was conducted at two levels of detail. Semi-detailed (1:50,000 scale) soil mapping was conducted above the Manitoba Escarpment by examining soil profiles to at least one meter depth along road allowances and trails resulting in each soil inspection representing approximately 30 hectares. Occasional soil inspection traverses were made where soil complexity necessitated additional field observation. Detailed (1:20,000 scale) soil mapping was employed throughout the area below the Escarpment. Detailed mapping involved examination of soil profiles to a least one meter depth at approximately 150 meter intervals along traverses through sections resulting in each soil inspection representing approximately 10 hectares. The area covered by each mapping scale is indicated in Figure 1.

During the course of the field mapping, soil samples were taken at selected locations for soil characterization, salinity, and subsoil properties for irrigation suitability studies. Sixty-eight profiles were described in detail and sampled for physical and chemical characterization. Approximately 3,800 samples were taken for soluble salt content; soluble cations and anions analysis were conducted on approximately one quarter of the samples. Particle size analysis were conducted on approximately 160 selected samples taken from the area. Within the area below the Escarpment samples of soils from sixty-four drill sites were obtained at regular intervals to delineate stratigraphic changes to depths of 3 to 5 m; water table conditions have been monitored at 16 sites. Samples taken at the drill sites were analyzed for salt content and on selected samples, soluble cations and anions, hydraulic conductivity and saturation percentage were determined.

After a guide for classifying and naming the soils had been developed, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs. The detailed soil maps are presented on Township bases utilizing 1:20,000 scale aerial photograph mosaics. The semidetailed mapping is presented on 1:50,000 scale line maps.

SUMMARY

Overview of Study Area

The soil study of the Grey, Dufferin, Roland, Thompson and Stanley municipalities in south-central Manitoba encompasses an area of 325 112 ha; 267 540 ha was mapped at a scale of 1:20,000 on a photomosaic base, and 57 572 ha was mapped at a scale of 1:50,000 on a line map. The study consists of two main areas; the level to very gently sloping landscapes of the Manitoba Plain in the eastern portion and the hummocky to hilly terrain of the Saskatchewan Plain in the western portion. The steeply sloping Manitoba Escarpment separates the two areas.

The cool, subhumid climate of the area generally provides sufficient moisture to support dominantly grassland vegetation and the development of Chernozemic Black soils. Chernozemic Dark Gray and Dark Gray Luvisolic soils have developed under grassland-forest transition and deciduous forest vegetation at higher elevations of the Saskatchewan Plain. Mean annual temperature ranges from 1.9C above the Manitoba Escarpment to 3.2C at Morden, below the escarpment. Mean annual precipitation ranges from 487 (Roland) to 560 mm (Portage). Mean frost free period ranges from 116 days (Graysville) to 121 days (Morden). Mean soil water deficit calculated to the soft dough stage of wheat is less than 30 mm for the coarse loamy to clayey textured soils; the deficit may approach 100 mm in one year out of ten.

Soil parent materials below the Manitoba Escarpment, are dominantly lacustrine sediments of Glacial Lake Agassiz. Glacial till deposits with discontinuous lacustrine veneers dominate above the Escarpment; extensive sand and gravel beach deposits occur along the Escarpment at 300 to 380 m a.s.l.. The lacustrine sediments are moderately to strongly calcareous and range in texture from fine sand to clay. Topography associated with these sediments is smooth and level to very gently sloping. The soils are dominantly imperfectly drained with considerable areas of poorly drained soils on the finer textured sediments. Drainage improvements to the main waterways and local drains below the Escarpment have reduced the flooding and ponding problems so prevalent in the area. Seasonal water tables or saturated zones at 1 to 2 m depth are common throughout much of the level lacustrine deposits.

The study area has some of the most productive soils in the Province; excellent yields of cereals, corn, sunflower, canola, sugar beets and other horticultural crops are realized. Agricultural capability of the soils in the study area is summarized in Table 1. Most of the soils (87 percent of map area) are in Soil Capability Classes 1 to 3, with none to moderate limitations for growing regional crops. Approximately 42 003 ha (12.8 percent) are in Class 1; 134 048 ha (40.7 percent) are Class 2 and 106 942 ha (33.3 percent) are in Class 3. An additional 8 845 ha (2.7 percent) are marginally arable and placed in Class 4.

Wetness or soil drainage is the most common problem in Soil Classes 2 to 4. The areas affected are approximately 78 785 ha of Class 2W; 41 999 ha of Class 3W; and 827 ha of Class 4W. Areas of excessive wetness with limited drainage outlet occupy 4.5 percent of the area; 9 227 ha of 5W; 5 746 ha of 6W, and 19 ha 7W land.

Salinity where soluble salts are present in sufficient amounts to affect crop growth occurs in 5.5 percent of the surveyed area. There are approximately 13 863 ha of weakly saline soils, 3 355 ha of moderately saline soils and 557 ha of strongly saline soils. These saline conditions are common on the lower slopes of the Escarpment, on soils immediately to the east of the Escarpment, and in the area below the Darlingford moraine in the south-west part of the map area. Where seepage conditions occur, localized areas of moderately to strongly saline conditions can be found.

Approximately 83 120 ha or 25 percent of the area, are characterized by sandy to coarse loamy soils that have varying degrees of droughtiness. Capability for agriculture of these soils is as follows: 34 951 ha in Class 2; 38 463 in Class 3; 3 725 in Class 4; and 5 981 in Class 5. These soils are also susceptable to wind erosion.

Water erosion has occurred on strongly sloping landscapes within and above the Escarpment. Erosion in these areas is localized, usually occurring on knoll and upper slope positions.

In general, the dominant agricultural management problems in the area are maintenance of adequate surface drainage, adequate fertility and tilth. The soils should be managed to prevent organic matter loss from surface horizons by wind erosion in the lowlands, and, both wind and water erosion in sloping areas within and above the Escarpment.

Soil conditions which present problems for land uses related to engineering and recreation development are: soils affected by high seasonal water tables; soils with a high content of high shrink-swell potential clay; soils with slow to very slow permeability caused by high clay content; and soils underlain by variably textured, stratified, subsoil sediments.

Generalized soil maps at a scale of 1:125,000 were prepared for each municipality. The generalized maps provide an overview of the soil distribution and the landscape. It provides a basis for comparing the potential of large areas for general kinds of land use.

Table 1 Summary of Soil Capability for Agricultural and Soil Areas affected by Salinity and Erosion within the Rural Municipality of Dufferin, Grey, Roland, Stanley* and Thompson.

1a Summary of Soil Capability Classes by Municipality (Area in hectares)

CAPABILITY CLASSES	PROJECT TOTAL	RURAL MUNICIPALITY DUFFERIN	GREY	ROLAND	STANLEY*	THOMPSON
Towns Etc...	820	392	147	274	6	1
Class 1	42,003	11,418	2,455	14,997	3,139	9,994
Class 2	134,048	41,854	38,635	20,764	15,688	17,107
Class 3	106,942	31,724	40,591	12,257	9,038	13,332
Class 4	8,845	282	4,109	0	2,257	2,197
Class 5	16,448	3,004	3,400	164	5,068	4,812
Class 6	14,684	1,229	3,027	79	6,067	4,282
Class 7	66	0	55	0	9	2
Class 03	1,256	33	470	0	0	753
GRAND TOTALS	325,112	89,936	92,889	48,535	41,272	52,480

1b Summary of the Soil Areas(ha) Affected by Salinity

SALINITY CLASSES	PROJECT TOTAL	RURAL MUNICIPALITY DUFFERIN	GREY	ROLAND	STANLEY*	THOMPSON
WEAKLY (s)	13,863	1,684	239	3,569	3,684	4,687
MODERATE (t)	3,355	0	33	0	1,287	2,035
STRONGLY (u)	557	0	0	0	0	557
TOTALS	17,775	1,684	272	3,569	4,971	7,279
%	5.5	1.9	0.3	7.4	12.0	13.8

1c Summary of the Soil Areas(ha) Affected by Erosion

DEGREE OF EROSION	PROJECT TOTAL	RURAL MUNICIPALITY DUFFERIN	GREY	ROLAND	STANLEY*	THOMPSON
OVERBLOWN (0)	6,242	3,832	2,267	100	0	43
SLIGHTLY (1)	10,168	2,844	2,104	5	2,404	2,811
MODERATELY(2)	804	312	137	0	280	75
ERX **	7,832	0	0	0	4,967	2,865
OTHER***	2,625	851	1,541	0	171	62
TOTALS	27,671	7,839	6,049	105	7,822	5,856
TOTAL (0,1,2)	17,214	6,988	4,508	105	2,684	2,929
% (0,1,2)	5.3	7.8	4.8	0.2	6.5	5.6

NOTES: *Summaries of R.M. of Stanley apply only to that portion surveyed in this report.
**Eroded Slope Complex
***Skelding, Stallar, Worden soils

Municipality Summaries

DUFFERIN MUNICIPALITY

Area

89 936 ha surveyed at a scale of 1:20,000.

Surface Deposits

The dominant surficial deposits in the R.M. of Dufferin are level lacustrine deposits associated with sandy sediment in the Lower Assiniboine Delta, variable deposits of moderately coarse to fine textures in the Red River Plain, and localized areas of recent fluvial sediments along stream channels (Boyne River and creeks from the Escarpment). Gravelly sands and loamy till occur within the southwest corner of the municipality. Localized areas of sand dunes occur in the northwest part and in the vicinity of the Stephenfield Reservoir.

Soil Capability for Agriculture

Soils developed on the moderately coarse to fine textured sediments that range in agricultural capability from Class 1 to 3 comprise 94.5 percent of the municipality. Approximately 11 418 ha are Class 1; 41 854 ha are Class 2; and 32 256 ha are Class 3. Sandy soils mainly west of Carman and north of the Boyne River are dominantly Class 2 and 3.

Salinity is a problem that occurs on approximately 1 684 ha, of which 75 percent occurs on clayey soils with improved drainage. Soils with improved drainage and which require regular drainage maintenance occupy 15 300 ha. Sandy soils associated with duned conditions are in Class 5 or 6; stabilized dune areas that could be or are being used as improved pasture are in Class 5.

Agricultural Land Use

Most of the moderately coarse to fine textured soils are used for cereals, flax and canola; moderately coarse to moderately fine textured soils have also been used for special crops such as potatoes, corn, soybean and peas. Level sandy soils with minimal to slight erosion are used for cereal grain production with some areas of corn, potatoes and canola. Sandy soils with moderate erosion and improved drainage are utilized for mixed farming with dominantly grass-legume production; minor areas are used for cereal grains.

Soil Management Problems

The main problems on clayey soils are maintenance of adequate surface drainage, soil structure and tilth.

Management practices on sandy soils, such as continuous cropping, crop rotations (which include forage) and minimum tillage, will help to maintain organic matter content and reduce soil erosion by wind. Level sandy soils hav-

ing a seasonal high water table frequently are saturated in spring; this can significantly delay seeding operations. However, precautions must be taken not to overdrain or attempt to maintain the water table at too low a level since these soils have a low water holding capacity and can become very droughty.

Soil Properties Affecting Engineering or Recreation Uses

Clayey soils to the east of Carman have high shrink-swell properties and are very plastic. Slow to very slow permeability results in surface ponding and slow runoff unless adequate drainage is provided.

Sandy soils in the R.M. of Dufferin generally have a high seasonal water table, rapid permeability, low moisture retention capacity and are subject to wind erosion. Local areas of highly calcareous soils have very low bearing capacity when moist to wet; they are also susceptible to considerable ice lensing and frost heave.

A more detailed summary of the extent of the soil series and phases within Dufferin Municipality is provided in Part 4 . A generalized soil map at a scale of 1:125,000 is provided in Appendix E.

GREY MUNICIPALITY

Area

92 889 ha surveyed at a scale of 1:20,000.

Surface Deposits

The two dominant surficial deposits in the R.M. of Grey consist of the sandy glacio-fluvial and lacustrine deposits of the Assiniboine Delta, and, the clayey deposits of the Red River Plain. The sandy deposits vary in thickness from one meter adjacent to the clayey area to greater than 5 meters on the western part of the municipality. Localized areas of medium textured sediments occur in the vicinity of St. Claude. Eolian sand dunes are common in the northwestern part of the municipality.

Soil Capability for Agriculture

The majority of the soils (84 percent) in the municipality are in Capability Class 2 (38 635 ha or 41 percent) and Class 3 (40 591 ha or 43 percent). Only 2 455 ha (2.5 percent) are considered to be Class 1. The main soil limitations are wetness, droughtiness and to a minor degree, soil degradation due to wind erosion. Approximately 25 899 ha have moderate limitation due to wetness (2W) of which 20 408 ha are moist clayey soils. Approximately 12 651 ha of sandy soils have moderate limitations due to droughtiness (2M).

Soils in Capability Class 3 have moderately severe limitations resulting from problems due to continuing wetness (3W) and droughtiness (3M). Approximately 19 739 ha of poorly drained clayey soils with improved drainage experi-

ence continuing wetness problems following periods of high rainfall or rapid spring snow melt. Sandy soils with moderately severe to severe droughtiness problems occupy 20 604 ha (3M) and 3 235 (4M) respectively. These soils are susceptible to erosion by wind and require good crop residue management to minimize this risk.

Arable sandy soils are dominantly Class 3 and 4 due to low organic matter, surface erosion and low moisture retention capacity. Sandy soils with seasonal high water tables varying between 0.75 and 1.5 meters of the surface throughout the summer are considered as Class 2 since water through capillary rise is able to provide water to plants and mitigate droughtiness.

Stabilized duned sandy soils are placed in Capability Class 5 or 6. Poorly drained sandy soils (5W) with minimal drainage outlets occupy 2 389 ha. Poorly drained soils with peaty layers are classed as 6W and occupy approximately 2 544 ha of which sandy peaty phase soils occupy approximately 2 310 ha. Deeper organic soils (Perillo and Xavier series) are classed as 03W and occupy approximately 470 ha.

Agricultural Land Use

Imperfectly drained clayey soils (Class 2W) are used for grain and pulse crops; level to depressional clay soils with improved drainage (3W) are used for dominantly grain production.

Capability Class 2, 3, and 4 on sandy soils are used for production of cereal grains, corn, flax, canola and legumes. Duned areas rated in Class 5 and 6 are used for native grazing or limited grass-legume production.

Soil Management Problems

The main problems on clayey soil are maintenance of adequate surface drainage, structure, and tilth. Sandy soils require careful management to keep soil erosion to a minimum; these include the maintenance of sufficient trash cover, shelter belts, and suitable crop rotations. Precaution must be taken not to overdrain poorly drained sandy soils since drainage of low lying areas could result in lowering the water table of adjacent better drained land areas and increase the risk of droughtiness.

Soil Properties Affecting Engineering or Recreation Uses

Clayey soils have slow to very slow permeability, high shrink-swell properties, and are very plastic. They are also subject to surface ponding and slow runoff unless adequate drainage is provided. Subsoils at a depth of 1 to 2 m are weakly saline; the average electrical conductivity is about 4 to 5 dS/m and composition of the salts is mainly magnesium and calcium sulfates.

Sandy soils have high seasonal water table, rapid permeability, low moisture retention capacity and are subject to wind erosion. The associated highly carbonated St. Claude soils have very low bearing capacity and are subject to considerable ice lensing and frost heave.

A more detailed summary of the extent of soil series and phases within the Municipality is provided in Part 4. A generalized soil map at a scale of 1:125,000 is provided in Appendix E.

ROLAND MUNICIPALITY

Area

48 535 ha surveyed at a scale of 1:20,000.

Surface Deposits

The dominant surficial deposits in the R.M. of Roland are the moderately coarse to fine textured variable deposits of the Red River Plain and localized areas of recent fluvial sediments along creek channels. The moderately coarse textured deposits occur as low beach ridges oriented in a northwest to southeasterly direction and are often underlain by clay at approximately one meter depth. The medium to moderately fine textured deposits occur in the western part of the municipality and are usually underlain by clay. Deep clay deposits are dominant in the east half of the municipality.

Soil Capability for Agriculture

The R.M. of Roland is well endowed with excellent agricultural soils. The moderately coarse to fine textured soils in the municipality range in soil capability from Class 1 to 2 and comprise 74 percent of the total area of the municipality. Approximately 14 997 ha are rated in Capability Class 1 and 20 764 ha are Class 2.

It is estimated that 12 257 ha or 25 percent of the soils are in Class 3. A moderate limitation to agricultural use results from wetness on approximately 10 490 ha. Slight salinity is a limitation on 3 569 ha, of which 2 316 ha are included with the soils which have a moderate limitation of wetness.

Agricultural Land Use

The dominant land use in the municipality is for agricultural crop production. Moderately coarse to moderately fine textured soils are used for cereal grains and for special crops such as corn, potatoes, sugar beets, canola, flax and peas. Cereal grains and flax are the dominant crops on the clayey soils.

Soil Management Problems

While most of the soils in the R.M. of Roland are judged to be free of, or only slightly affected by limitations for arable agriculture, fine and moderately fine textured soils require the maintenance of adequate surface drainage, soil structure and tilth. The sandy moderately coarse textured soils require careful management to reduce the risk of wind erosion; this includes leaving crop residues to provide sufficient trash cover, the provision of shelter belts, minimum tillage practices, and crop rotation including a forage crop to maintain productivity

Soil Properties Affecting Engineering or Recreation Uses

Clayey soils have slow to very slow permeability, high shrink-swell properties and are very plastic. They are subject to surface ponding and slow runoff unless adequate drainage is provided. The moderately coarse to moderately fine textured soils have moderate to moderately rapid permeability, seasonal high water table or a saturation zone above the clay subsoil particularly in spring or following heavy rains.

A more detailed summary of the extent of soil series and phases in Roland Municipality is provided in Part 4. A generalized soil map at a scale of 1:125,000 is provided in Appendix E.

STANLEY MUNICIPALITY

Area

41 272 ha within the R.M. of Stanley is covered in this report. Soils information for this area above the Manitoba Escarpment is presented on a line map at a scale of 1:50,000. The balance of the area in the municipality (44 030 ha) is described in the Morden-Winkler Soil Report No. 18.

Surface Deposits

Along the Manitoba Escarpment, the surface deposits consist of variable depths of water laid gravelly sands to clay overlying glacial till and shale bedrock. Gravelly sand beaches occur as terraces; backbeach areas of water laid sediments are dominantly loam to clay in texture and often contain considerable stones. In some areas, the depth of clay may be 2 meters or more. Shale outcrops are commonly exposed along the steeper slopes and ravines.

The upland area above the Escarpment consists dominantly of strongly to very strongly calcareous glacial till of granitic, limestone and shale bedrock composition; minor areas have lacustrine veneers. The till varies in thickness from 1 to 20 meters.

Soil Capability for Agriculture

Approximately 3 139 ha (7.6 percent) of the soils in the project area are in Class 1 with essentially no limitations to use for crops.

Soils above the Escarpment are mainly in soil Capability Class 2 and 3; approximately 15 688 ha are in Class 2 (38 percent) and 9 038 ha are in Class 3 (22 percent).

Salinity occurs in areas along the base of the Escarpment and adjacent to the lower slopes of the Darlingford Moraine in the southwest part of the municipality. Approximately 4 971 ha (12 percent of the mapped area) is salt affected consisting of 3 684 ha of slightly saline soils, and 1 287 ha of moderately saline soil. Soil structure is affected within and adjacent to the saline areas; there are approximately 2 968 na of soils with moderately severe

structure limitation (Class 3D) and 707 ha of soils with severe structure limitations (Class 4D). Other soil and landscape limitations to agricultural use include approximately 1 200 ha in Capability Class 4 and 5 due to shallow depth of soil to shale bedrock; about 5 033 ha of steeply sloping, eroded valley walls and ravines that are dominantly Class 6T, and approximately 2 084 ha in Class 5 and 593 ha in Class 6 due to wetness or poor drainage.

Agricultural Land Use

Non-saline, medium to moderately fine textured lacustrine soils are suitable for all regional and special crops. The upland tills are used dominantly for cereals, flax, canola and forage crops. Clayey soils are used for cereal grain production, with limited flax and canola. The Escarpment and dissected landscape provides an esthetic area for outdoor recreational activities.

Soil Management Problems

Upland soils on moderately to strongly sloping hummocky till are subject to wind and water erosion, if exposed with little trash cover. Clayey soils along the Escarpment have high shrink-swell and very plastic properties, poor structure, and may contain appreciable soluble salts. Level areas adjacent to emerging creek channels are subject to flooding and ponding. Some improvements has been made through provision of adequate drainage and diking of waterways from the Escarpment.

Soil salinity is common along the lower slopes of the Escarpment. On some ridged and terrace-like areas, the depth to shale bedrock is shallow; the upper weathered zone has very low permeability, high shrink- swell characteristics and contains soluble salts. Surface stones constitute a considerable impediment to land use along many of the water modified terraces along the Escarpment.

Properties Affecting Engineering or Recreation Uses

Extreme soil variability over short distances in the Escarpment area combined with steeper slopes and the occurrence of shale bedrock at or near the surface can affect engineering uses. Large concentration of stones, boulders and gravel lags occur locally in terraced areas; these may affect many recreation uses. However, the dissected landscape of the Escarpment area provides an esthetic setting for outdoor recreational activities such as hiking and viewing.

Soils below the Escarpment are affected by seepage areas, high water table and variable salinity. Soils adjacent to creek channels are subject to flooding during periods of high runoff. Clayey soils in the area have seasonal high water table, high shrink-swell properties and are slowly permeable.

A more detailed summary of the extent of soil series and phases within the municipality is provided in Part 4. A generalized soil map at a scale of 1:125,000 is provided in Appendix E.

THOMPSON MUNICIPALITY

Area

52 480 ha total area surveyed of which 36 180 ha is mapped on a photomosaic map base at a scale of 1:20,000 and 16 300 ha is shown on a line map at a scale of 1:50,000.

Surface Deposits

The R.M. of Thompson includes areas both above and below the Manitoba Escarpment. Surface deposits in the municipality are complex as a result of glacier advance overriding the shale bedrock-controlled Escarpment area, and subsequent erosion along the Escarpment, and lacustrine deposition by the waters of Glacial Lake Agassiz. Above the Escarpment, the surface deposits consist of strongly to very strongly calcareous, loam to clay loam textured glacial till. The till thickness varies from less than 1 m along the leading edge of the Escarpment to approximately 20 m to shale bedrock in areas above the Escarpment. Minor areas of thin lacustrine veneers of dominantly clay loam texture occur over the till. In the southwestern part of the municipality, surface deposits are dominantly weakly calcareous shaly till; a local, but significant, area of shallow peat occurs within one large poorly drained depression.

Within the Escarpment area, surface deposits range from beach sands and gravels to back beach deposits of loam to clay textured sediments overlying till and shale bedrock. The terrain has been dissected by deep ravines,as a result of post-glacial erosion and mass wasting; shale outcrops are common.

Below the Escarpment, the surface deposits are dominantly medium to fine textured lacustrine sediments; localized recent fluvial sediments along creek channels and adjacent overflow areas. Sandy deposits are common in the northwest part of the municipality.

Soil Capability for Agriculture

Approximately 77 percent of the soils in the municipality are in Capability Classes 1 to 3; soils occur on medium textured sediments below the Manitoba Escarpment and occupy some 9 994 ha. An additional 17 107 ha are in Class 2 and 13 332 ha are in Class 3.

Most of the soils in the rougher, hummocky terrain above the Escarpment and dissected areas along the Escarpment range in agricultural capability from Class 4 to 6, depending on the slope and degree of surface erosion. Approximately 2 865 ha are in Class 6T and cannot realistically be improved for agricultural use. Sandy and gravelly soils in the terraced beach areas are in Class 4 and 5 due to droughtiness. Soils in the lower Escarpment area and adjacent level areas to the east are influenced by seepage water containing soluble salts. Approximately 7 279 ha are affected by varying degrees of salinity, approximately 4 687 ha are slightly saline, 2 035 ha are moderately saline, and 557 ha are strongly saline. Clayey soils associated with salinity often have poor structure due to the dispersive effects of leaching sodium salts; approximately 8 977 ha of soil in capability Classes 2 and 3 have moderate to moderately severe limitations due to poor structure and tilth.

Agricultural Land Use

Non-saline, medium to moderately fine textured lacustrine soils in the municipality are suitable for all regional and special crops. Clayey soils are used for cereal grain production, with limited use for flax and canola. Sandy soils are utilized for mixed farming consisting of cereal grains, forage and areas of natural grazing. The upland soils west of the Escarpment are used dominantly for cereals, flax, canola and forage crops.

Soil Management Problems

Soils below the Escarpment are dominantly imperfectly drained and have high seasonal water table. Clayey soils, and medium to moderately fine textured soils that are underlain by clay, require some surface drainage. Runoff from the Escarpment causes flooding problems along the creeks and waterways. Clayey soils have high shrink-swell properties, low permeability, poor structure and may contain appreciable soluble salts. Sandy soils have high seasonal water table, rapid permeability, low water retention capacity and are subject to wind erosion. Upland soils above the Escarpment on rougher, hummocky topography are susceptible to water erosion; some areas have experienced significant soil and nutrient loss.

Properties Affecting Engineering or Recreation Uses

Soil conditions throughout the Escarpment area are extremely variable over short distances. Such variability, combined with steep slopes of the area and shallow depth to shale bedrock, affect utilization of the soils for engineering or recreation purposes.

Soils below the Escarpment are affected by seepage, high water table, variable salinity and occasional flooding during high runoff periods. Clayey soils in the area have slow permeability and high shrink-swell properties. Sandy soils are affected by water table close to the surface for extended periods.

Shaly clay till soils in the southwestern part of the municipality are difficult to compact and unstable when saturated.

A more detailed summary of the extent of the soil series and phases within the municipality is provided in Part 4. A generalized soil map at a scale of 1:125,000 is provided in Appendix E.

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PART 1

GENERAL DESCRIPTION OF THE STUDY AREA

1.1 LOCATION AND EXTENT

This soil study area is located in south central Manitoba (Figure 1) within the limits of Township 1 to 9, Range 3 to 7W, and provides coverage of approximately 325 112 ha for the Municipalities of Grey, Dufferin, Thompson, Roland, and part of Stanley.

This project provides more detailed soil information for portions of the land area previously reported in the South Central Map (Ellis and Schafer, 1943), a portion of the Winnipeg-Morris Map (Ehrlich et al, 1953), and part of the Carberry Map (Ehrlich et al, 1957).

The soil study was conducted at two scales or levels of detail. The more detailed investigation was conducted below the Manitoba Escarpment on approximately 267 540 ha and information presented at a map scale of 1:20,000; less detailed investigations were conducted above the Manitoba Escarpment on 57 572 ha and this information presented at a map scale of 1:50,000 (Table 2).

Within the municipality of Grey, approximately 3 626 ha in the west part of Twp 9 Range 7W was included in the West Portage and MacGregor Map (Michalyna et al, 1982); this information was reproduced and is included in this report.

In the Stanley Municipality, soil information is presented at 1:50,000 scale for approximately 41 272 ha. Additional information from the detailed Study of the Lake Minnewasta Area (Podolsky, 1979) was generalized and also included in this study. Correlation information is provided for the previously published detailed reports at 1:20,000 for the Morden-Winkler Report (Smith and Michalyna, 1973) and the Lake Minnewasta Report (Podolsky, 1979).

1.2 LAND USE

Agriculture is the dominant land use in the study area. Other important but local uses of land are for urban residential, rural residential, industry, recreation and wildlife.

Three main kinds of agriculture in the study area consist of cereal grain production, mixed farming and production of special crops. Cereal grain production dominates on gently undulating and low relief hummocky terrain above the Manitoba Escarpment. Major crops are wheat, barley, flax and canola. Mixed farming occurs mainly within rough hummocky terrain above the Escarpment, in dissected portions of the Escarpment, on salt-affected and flood-prone soils along the lower slopes of the Escarpment and in sandy erosion prone and drained areas below the Escarpment. Farm enterprises vary from dominantly cereal grain production to combination of grain with pulse crops, forage and pasture and cattle, hog and poultry operations. Special crop production is most common on the level loam to clay textured soils in eastern portions of the study area.

In addition to the common cereal crops, a wide variety of pulse and horticultural crops are grown including corn, flax, canola, sunflower, buckwheat, sugar beets, potatoes and vegetables.

Commercial enterprises serving agriculture and light industry developments are located adjacent to population centers and along major highways. Land area used in this way is local and small in extent.

Many recreation activities in the study area center on land areas adjacent to Lake Minnewasta and the Stephenfield Reservoir. Ski facilities have been developed in steeply sloping portions of the Manitoba Escarpment near Roseisle.

Camp grounds and picnic sites are located to take advantage of the diverse terrain and aesthetics of the Escarpment area. Steeply sloping and heavily woody portions of the Escarpment provide good habitat for wildlife. Whitetail deer and upland gamebird populations of this terrain provide a base recreational hunting.

Subdivision of land for housing occurs mainly within and adjacent to established town and village sites. There is however much interest in subdivision for rural living particularly along the Escarpment and in the vicinity of the reservoirs and ski slopes.

TABLE 2

Summary of the Soil Study Coverage and Scale of Mapping for the Municipalities of Dufferin, Grey, Roland, Stanley and Thompson

Municipality	Total Area(ha)[1]	Surveyed Area (ha)	Map Scale 1:50,000	1:20,000
Dufferin	89 936	89 936		89 936
Grey	92 889	2 889		92 889(a)
Roland	48 535	48 535		48 535
Stanley	85 302	41 272	41 272	(b,c)
Thompson	52 480	52 480	16 300	36 180
Total	369 142	325 112	57 572	267 540

a) Michalyna et al 1982 (Portage West Report D20 3 626 ha in 9-7W reproduced)
b) Smith and Michalyna 1973 (Morden-Winkler) 44 030 ha in Stanley)
c) Podolsky 1979 (Lake Minnewasta, 2 560 ha).
1) Areas reported may be 1-2% off due to complete estimates and rounding off.

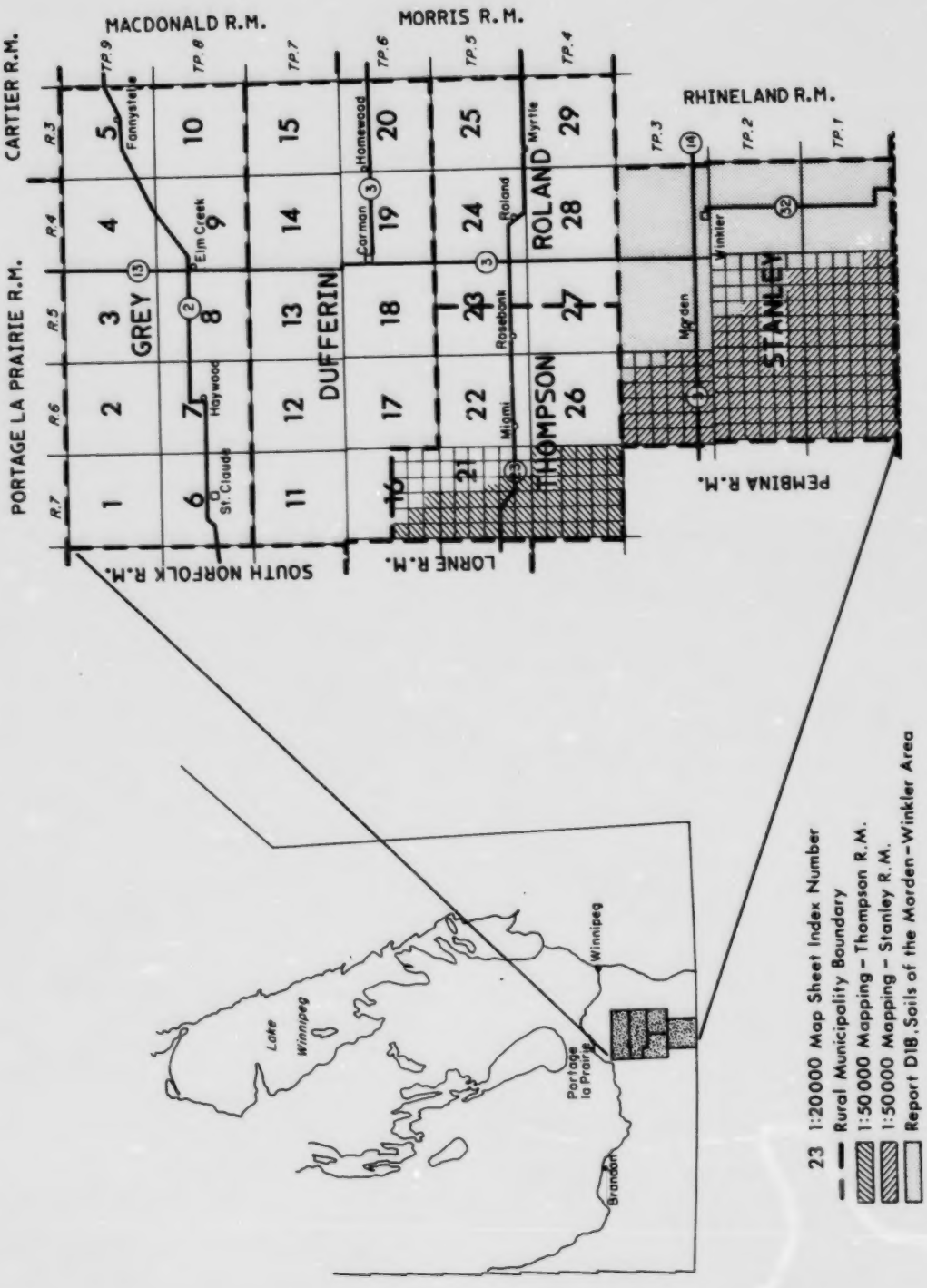


Figure 1: Map of the D60 Soil Study Area and scale of coverage.

PART 2

FACTORS AFFECTING SOIL FORMATION

The principal factors affecting soil formation are climate, vegetation, parent material, relief and drainage. The interaction of these soil forming factors is expressed in the morphological characteristics of soil. The type of soil formed at any one place in the landscape is also dependent on the length of time the soil forming factors have been operative and modification resulting from the work of man.

2.1 PHYSIOGRAPHY

The study area occurs within the Great Plains Province of the Interior Plains of North America. The generally low relief of the Interior Plains is due primarily to the flat-lying nature of the underlying sedimentary rocks of Paleozoic and Cretaceous Age.

The study area straddles major physiographic subdivisions known as the Manitoba Plain or Lowlands occurring below approximately 300 m and the Saskatchewan Plain or western Uplands occurring at higher elevation and to the west. The more strongly sloping area bordering the two divisions is commonly known as the Manitoba Escarpment (Figure 2).

The physiography and surface deposits of the study area are a direct result of advancing continental ice sheets during the last stages of the Pleistocene Period (ice age). The entire area was covered by several major advances of ice followed by retreat to the north when glacial lakes were formed. The last stage of glaciation, known as the Wisconsinan Glaciation initially advanced over the study area sometime prior to 20,000 years before present (B.P.) (Fenton et. al., 1983). Retreat of this ice sheet from the last advance began shortly after 11,000 B.P. resulting in the formation of Glacial Lake Agassiz in the Manitoba Plain east of the Manitoba Escarpment. The Escarpment formed the western shore of this huge water body and wave action developed extensive beach complexes and areas of eroded terraces. During the history of Lake Agassiz, extensive areas of sandy to clayey lacustrine sediments were deposited on the Manitoba Plain. Sandier materials were deposited in association with major deltas formed where meltwater spillways of the Assiniboine and Pembina rivers flowed into the glacial lake. Minor beach ridges paralleling the Escarpment formed when the lowering lake levels stabilized as Lake Agassiz retreated from the study area. Deep clayey and silty sediments occur further into the lake basin where deposition continued until Lake Agassiz drained from the study area some 9,000 years ago. Following drainage of Lake Agassiz local streams and rivers flowing from the Escarpment eroded and carried clay materials from the shale bedrock underlying the Escarpment. Subsequent deposition occurred as fluvial fans covered the sandy materials immediately adjacent to the Escarpment. Dates for this alluvial material suggest that it is younger than Glacial

Lake Agassiz beginning some 3,000 to 6,000 years ago.

The Saskatchewan Plain portion of the study area has been divided into sections referred to as the Pembina Hills Upland (E3) and the Pembina River Plain (E7); the subsections are the Pembina Hills (E3.1),Pembina Escarpment (E3.2) and the Manitou Plain (E7.2) respectively.

The Pembina Hills (E3.1) are dominantly characterized by undulating to hummocky morainal landscapes with moderate to strong slopes and associated sloughs. These landscapes occur at elevations between 390 to 500 m a.s.l.

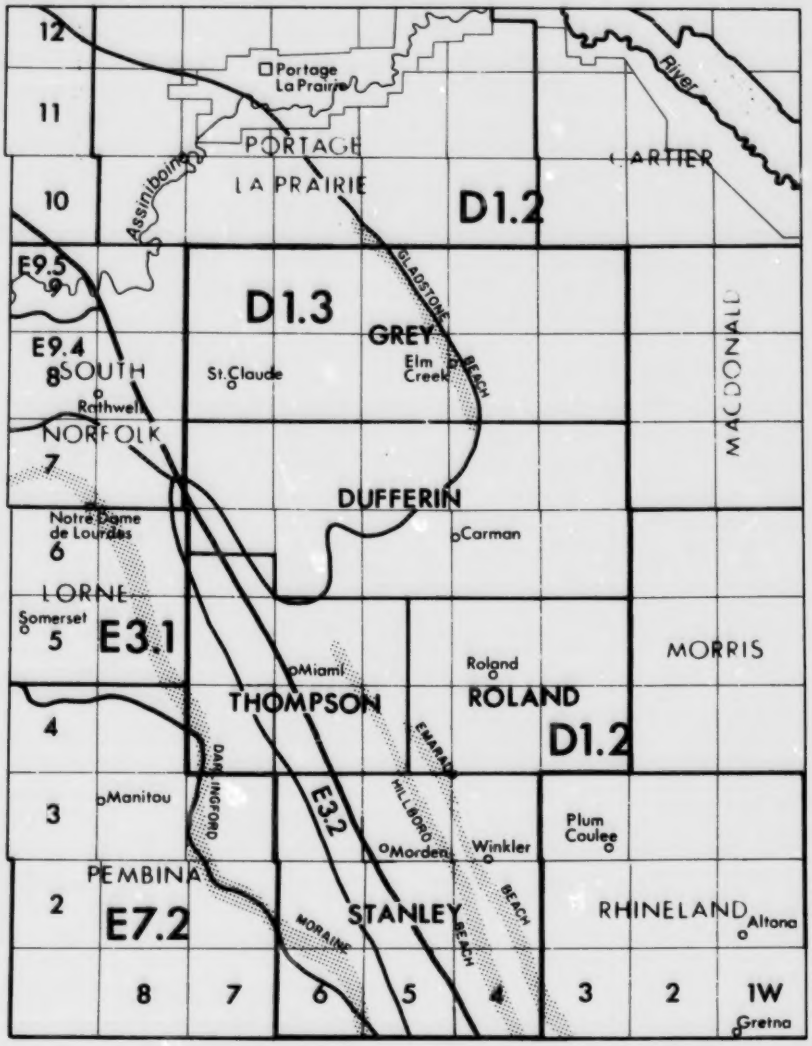
The Manitou Plain (E7.2) occurs at an elevation of 460 to 500 m a.s.l. and is characterized by undulating to rolling landscapes associated with thick morainal deposits, morainal veneers and morainal blankets. The topography generally conforms to the eroded surface of the shale bedrock. Shale bedrock occurs near the apices of the undulating landscapes with prominent relief.

The Manitoba Escarpment portion of the study area is known as the Pembina Escarpment (E3.2). The Escarpment occurs along the east facing slopes of the Pembina Hills and is marked by pronounced change in slope and landform. The change in gradient varies from 1 to 3 percent (50 to 100 m elevation change in a distance of 3 to 5 km) along the midslope to the base of the Escarpment, with more abrupt changes occurring along the upper slopes and particularly west of Miami where gradients exceed 10 percent (30 m rise per distance of 0.3 km). In areas of low gradient, numerous terraces and beaches of glacial Lake Agassiz are common. The escarpment area is dissected by deep, incised, intermittent streams which have cut into the surficial deposits and into the underlying Cretaceous shale bedrock.

The Manitoba Plain portion of the study area is comprised of the Red River Plain Section (D1) which is divided into the Red River Valley (D1.2) and the Lower Assiniboine Delta (D1.3) Subsections.

The Red River Valley (D1.2) is a level to gently sloping lacustrine plain which occurs below elevations of 320 m a.s.l. The western portion has a gradient of less than 0.5 percent and is broken by a series of low beach ridges oriented in a NW-SE direction parallel to the Escarpment.

The Lower Assiniboine Delta (D1.3) is characterized by a level, deltaic and lacustrine plain with localized areas of sand dunes. These landscapes occur at elevations between 255 to 315 m a.s.l.



DIVISION		SECTION		SUBSECTION	
D	MANITOBA PLAIN	D1.	RED RIVER PLAIN	.2	RED RIVER VALLEY
				.3	LOWER ASSINIBOINE DELTA
E	SASKATCHEWAN PLAIN	E3.	PEMBINA HILLS UPLAND	.1	PEMBINA HILLS
				.2	PEMBINA ESCARPMENT
		E7.	PEMBINA RIVER PLAIN	.2	MANITOU PLAIN
		E9.	ASSINIBOINE RIVER PLAIN	.4	BRANDON LAKE PLAIN
				.5	UPPER ASSINIBOINE DELTA

Canada - Manitoba Soil Survey, unpublished data

Figure 2: Physiographic Map of the Study Area.

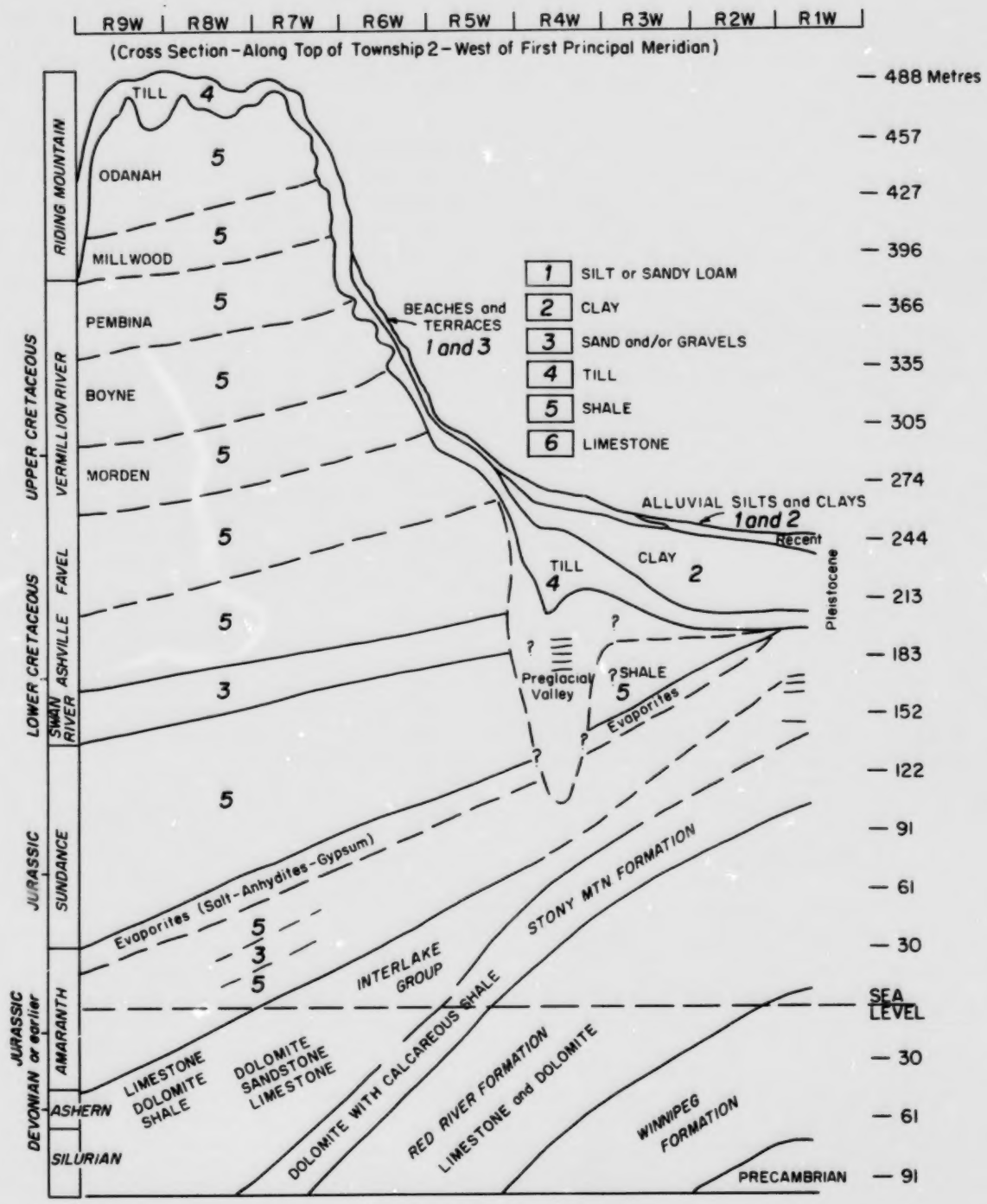


Figure 3: Cross Section of the Geological Formations and Surface Deposits in the Study Area.

2.2 BEDROCK GEOLOGY

The bedrock formations underlying the study area belong to the Upper and Lower Cretaceous Periods of the Mesosoic Era (Figure 3). High elevations in the western portion of the study area are underlain by the hard siliceous shales of the Riding Mountain Formation (Odanah and Millwood members) At lower elevations along the steeply sloping Manitoba Escarpment older shale bedrock of the Vermillion River Formation (Morden and Boyne members) are exposed at/or near the surface.

Low lying and level terrain to the east of the Escarpment is underlain by Cretaceous shale of the Favel and Ashville formation, and sandstone of the Swan River formation. Depth of overburden ranges from 30 m near the Escarpment to in excess of 100 m in the eastern portion of the study area.

More detailed description of the bedrock characteristics of the study area are provided by Bannatyne (1970) and Teller (1976).

2.3 SURFACE DEPOSITS

Pleistocene glaciation, glacial melt waters and subsequent inundation by waters of Glacial Lake Agassiz has resulted in depostion of variable depths of glacial till, fluvial deposits and lacustrine sediments in the study area. The surface deposits vary in form and properties within each physiographic area depending on characteristics of the bedrock from which they were derived and the way in which they were transported and deposited.

The surface deposits in the Pembina Hills consists dominantly of glacial till derived from shale, limestone and granitic rock origin. They are moderately to very strongly calcareous and have a dominant texture of loam to clay loam. The thickness of the till over bedrock commonly varies from 1 to 10 m, and in localized areas ranges to 30 m. At lower elevations in the landscape and along broadly defined waterways, thin veneers, up to 90 cm thick, of clay loam to light clay textured lacustrine sediments overlie the till. Localized deposits of deeper silty sediments occur to the west of and within the Darlingford moraine. Minor areas of shallow till over the silts occur on the northeastern part of the moraine. This sequence of till over the lacustrine sediments indicate that the glacier overrode the lacustrine sediments in the area. Minor areas of glacial fluvial sands and gravels are found mainly along former glacial meltwater channels.

The surface deposits in the Manitou Plain consists of thick morainal deposits, morainal veneers and morainal blankets. These deposits are dominantly weakly calcareous till of shale and granitic rock origin; minor areas of moderately to strongly calcareous till of shale, limestone and granitic origin are also present. The thickness of these deposits is generally less than 5 m over shale bedrock and may be less than 1.0 m on the apices of some of the more prominent ridges. In some areas the depth of overburden may exceed 35 m to shale bedrock. Localized deposits of shallow lacustrine deposits occur throughout the plain; they are moderately to strongly calcareous with dominant textures of loam to clay loam; some strata contain considerable silt.

Surface deposits along the Pembina Escarpment vary in texture, mode of deposition and depth to shale bedrock. These surface deposits consist of shallow till over bedrock, terraced outwash and beach deposits of

dominantly sand and gravel, with fluvial deposits ranging in texture from sands to clay as infill between the beaches (Figure 3). Till, consisting of moderately to strongly calcareous material of shale, limestone, and granite rock origin usually occurs at shallow depths (1.5 m) below the beach, outwash, or fluvial deposits; local areas of till may be found at or near the surface. The thickness of the till in the Escarpment area is commonly less than 1.5 m and is underlain by shale of the Morden, Boyne and Pembina Members of the Riding Mountain Formation.

Surface deposits in the Red River Valley range from sandy to clayey lacustrine sediments. In the western portion, sandy gravelly textured offshore deposits have been laid down as Lake Agassiz receded. Above the Hillsboro Beach (285 m a.s.l.), the sediments are dominantly stratified, sandy, and vary in thickness to three or more meters. Some shallow silty and loamy sediments occur within portions of the backbeach areas; clayey sediments occur along the base of the Escarpment and in flood prone areas associated with stream-flow from the Escarpment. East of the Hillsboro Beach the sediments are dominantly stratified silts and clays. The sediments contain greater proportions of clay in the central portion of the Red River Valley to the east. The silty deposits vary in thickness from approximately 2 m or more in the vicinity of the Hillsboro Beach to approximately 0.6 m in the vicinity of Jordan and Carman. East of this area the surface deposits are dominantly clayey, although localized areas of silty fluvial sediments are common. A few sandy ridges also occur.

Surface deposits within the Lower Assiniboine Delta are dominantly sandy deltaic and lacustrine sediments. Localized areas of dunes have resulted from modification by wind. The sandy deposits vary in depth from less than a meter adjacent to the clayey areas near Elm Creek to 11 or 12 m to the west. All of the sandy sediments are underlain by stratified silt and clay. Depth to bedrock is approximately 60 m in the Stephenfield area.

2.4 RELIEF AND DRAINAGE

Elevation in the study area varies from 250 m a.s.l. in eastern portions of the Red River Valley to 500 m a.s.l. in the Pembina Hills with the most noticeable change in relief occurring along the Manitoba Escarpment. Here the elevation changes from 320 to 390 m a.s.l. within a distance of several kilometers, (Figure 4). Below the Escarpment, the landscape is level to gently sloping with general gradients of 0.5 percent between the 290 to 320 m contours and gradients of less than 0.25 percent between the 260 m and 260 m contour, and 0.1 percent below the 260 m contour.

The Pembina Hills gradually increase in elevation from the Manitoba Escarpment west to the Darlingford moraine. Slopes on these hummocky landscapes vary from 3 to 25 percent or more; the steeper slopes more commonly occur in the area of the Darlingford moraine.

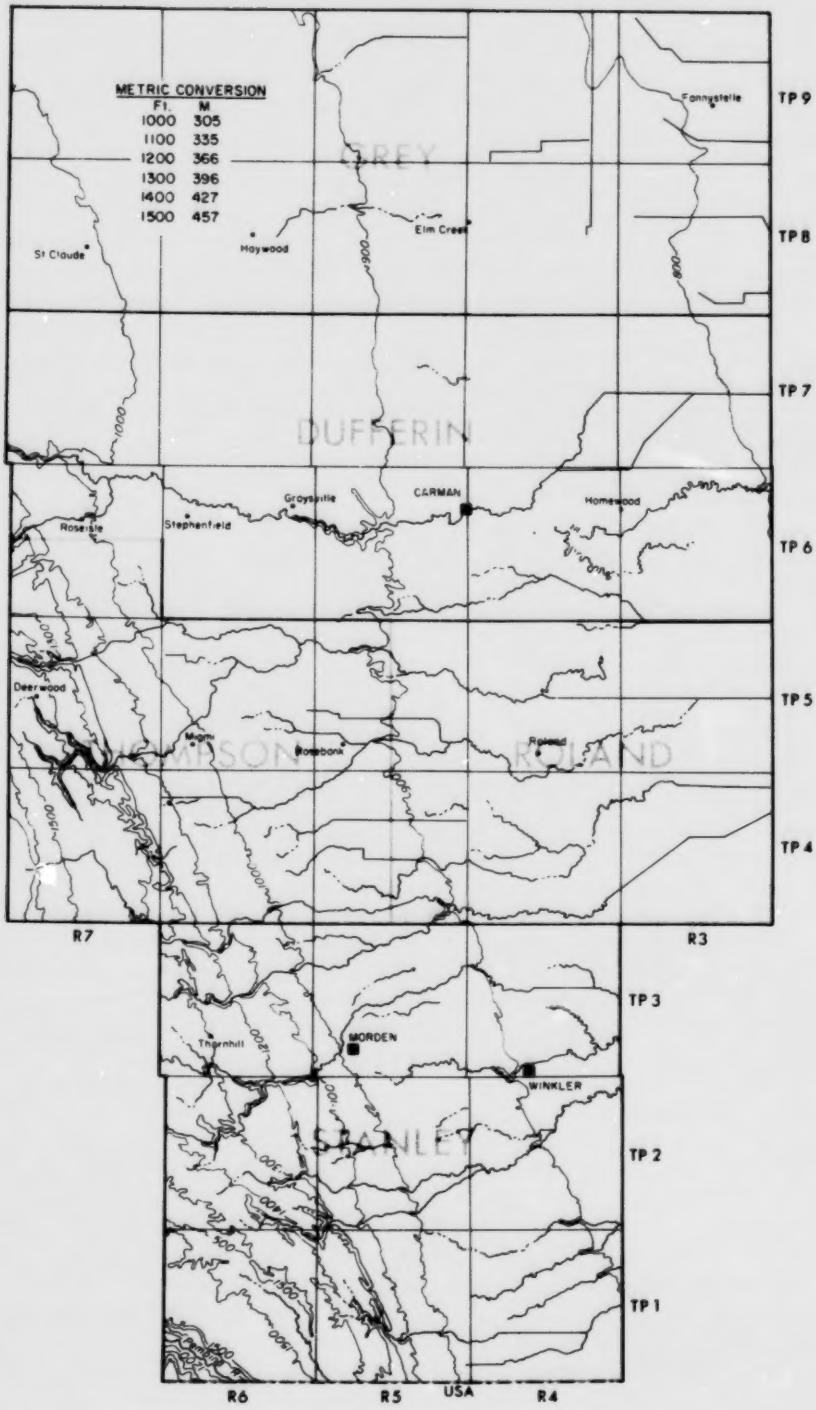


Figure 4: Relief and surface drainage in the study area.

Development of natural surface drainage varies within the study area. The Darlingford moraine in the Pembina Hills forms a drainage divide for the surface water flow of the area. Waters accumulating within the western part of the moraine and within the Manitou Plain flow south-westerly and southerly through various intermittent creeks and channels to the Pembina River. Surface waters to the east of the moraine flow easterly through numerous strongly incised creeks and channels across the Pembina Escarpment and onto the Red River Valley (Figure 4). Below the Escarpment, the drainageways become less noticeable resulting in considerable overland flow and associated ponding; extensive improvement in the drainage of the area has been developed with the construction of large diked drains extending from the base of the Escarpment eastward to the natural channels associated with the Boyne and Morris Rivers. The more prominent creeks and channels flowing from the Escarpment are Plum Coulee Creek, Deadhorse Creek, Shannon Creek, Tobacco Creek and Roseisle Creek.

Natural ponded areas or sloughs occur within the morainic landscapes of the Pembina Hills and Manitou Plain; drainage associated with these sloughs is very weakly developed.

Surface runoff and drainage in the terrain between the Escarpment and the Hillsboro Beach is generally good where the creeks have an adequate channel; in areas of overflow or where the channels are not well developed surface ponding and outlet restrictions remain a problem. Below the Hillsboro Beach, the gradient decreases and the channels are minimally developed and surface flooding can result during heavy runoff. Considerable improvement to the drainageways has been undertaken.

Surface drainage within the sandy Lower Assiniboine Delta is very weakly developed and has been slightly improved by the shallow drains associated with roadways. In some parts of the landscape, the water table may be within a meter of the surface throughout the spring and early summer. In fall and winter, groundwater levels are commonly between 1.5 to 2 m.

2.5 CLIMATE

In relation to world-wide climatic conditions, the study area occupies a position in the interior of North America beyond range of the moderating affects of oceans. Its location at mid-northern latitudes confers a continental climate with short, cool summers and long cold winters. The climate of the area is mainly influenced by three types of air masses; cold, dry air from the continental polar region, particularly in winter; cool and moist air from the Pacific and occasionally warm and moist air from the Gulf of Mexico. Frequent changes in these air masses contributes to extreme variability of weather pattern within each season.

Although weather patterns within each season may vary considerably, climatic condition are reasonably well represented by long term meteorological data from weather stations in the area. Climatalogical data from six of these stations are presented in Table 3. Other climatic parameters relevant to crop growth in the study area are presented in Tables 7 and 8 in Part 4 of this report.

Table 3. Climatic Parameters for the Morden, Graysville, Roland, Deerwood, Pilot Mound and Cypress River Stations (Environment Canada 1982).

Parameters	Morden CDA	Portage Airport	Graysville	Roland	Deerwood	Pilot Mound	Cypress River
Elevation m a.s.l.	297	264	283	267	338	475	375
Temperature ^{o}C (mean annual)	3.3	2.6	2.4	2.8	2.9	1.9	2.3
Precipitation mm (mean annual)	530	545	515	472	596	517	521
Rainfall mm (mean May 1-Sept.30)	336	342	318	298	350	335	335
mean - May	64.0	59.3	56.1	54.7	65.4	63.1	56.0
mean - June	75.8	75.7	75.4	73.5	87.7	79.0	81.0
mean - July	73.2	76.3	70.9	66.6	80.7	71.9	77.6
mean - August	71.1	81.0	63.7	55.8	65.6	64.0	73.9
mean - Sept.	51.6	49.9	51.6	47.5	50.1	57.2	46.7

Aerial Climate

The average annual temperature in the study area ranges from 1.9C at Pilot Mound to 3.3C at Morden (Table 3). In general, the area above the Escarpment is considered slightly cooler than the area along and below the Escarpment. Mean daily temperatures for January were -18.7C at Pilot Mound and -17.3C at Morden; mean daily temperatures for July were 18.6C at Pilot Mound and 20.3C at Morden.

Approximately 75 percent of the annual precipitation falls as rain during the late spring, summer and early fall season and 25 percent as snow during the five winter months of November to March.

Mean annual precipitation varies from 487 mm recorded at Roland to 620 mm recorded at Deerwood (Table 3). Mean rainfall for the period May thru August was 278 mm at Pilot Mound and 290 mm at Morden; mean rainfall for the period May thru September is 335 mm at Pilot Mound and 340 mm at Morden.

Spring and fall precipitation is often uniformly distributed resulting from low pressure systems passing through the area. In summer, when local showers and thunderstorms are most frequent, accumulation of rainfall is extremely variable from place to place. Average precipitation is lowest in the winter months because of the greater frequency of high pressure systems and the dominance of dry Arctic air masses.

Soil Climate

Soil climate consists of soil temperature and soil moisture both of which are related to aerial climate. Soil climate has a direct influence on most biological, chemical and physical processes in the soil. The distribution of soil climate regimes in the study area is related to the Ecoclimatic Regions shown in Figure 6. The dominant soil temperature regime of each region is described according to temperature classes defined for the Soil Climate Map of Canada (Department of Agriculture, 1972). and modified based on soil temperature measurements of Manitoba soils.

Soil climate conditions associated with freely drained loam textured soils in the study area are described as moderately cool to cool boreal, subhumid. These soils are characterized by a mean annual soil temperature of 5-8C and a mean summer soil temperature (June, July, August) of 15 to 18C at 50 cm. Finer textured soils (clay loam to clay) have a mean summer soil temperature of 12 to 15°C at the 50 cm depth.

Some soil climate data from selected soil temperature site, in this area of southern Manitoba are presented in Table 4. The annual pattern of soil temperature distribution at four depths in a coarse loamy Reinland soil are shown in Figure 5. Soil temperature follows a wave-like pattern in response to seasonal air temperature change, the response being more rapid near the surface and considerably slower in the subsoil. The soil gains heat during the period from May to August, and loses heat from September to March with general crossover periods in April and the latter part of September. At 20 cm, cultivated coarse loamy soils (Reinland series) freeze in early December and decrease in temperature to approximately -3C in response to very

cold air conditions in January and February (Figure 5). The time lag over which the lower soil strata freeze is noted at the 100 cm depth where freezing occurs in mid-January and at the 150 cm depth where freezing is delayed until mid February (Table 4).

Soils under grass cover (Site d, Table 4) or a tree canopy (sites a and b) tend to lose heat more slowly and freeze later than cultivated soils due to the insulating effect of vegetation and organic material at the surface. Soils with this cover generally accumulate thicker snow layers than cultivated soils with no vegetative cover. Surface soils with vegetative cover and thicker accumulation of snow also tend to remain frozen until approximately mid April (Table 4).

The moisture status of soils in the study area is described in terms of periods of saturation for poorly drained soils and according to length of period and degree of water deficit during the growing season for imperfectly and well drained soils. Although no soil moisture measurements have been made in the study area, this characteristic has been estimated for each soil type (Figure 6) according to criteria defined for the Soil Climate Map of Canada. Freely drained loamy soils in this area have a subhumid moisture regime characterized by unsaturated soil conditions with significant (50 to 250 mm) soil water deficits during the growing season. Soil water deficits will be larger on sandy soils with lower water holding capacity and smaller on clayey soils with higher water holding capacity. Extensive areas of imperfectly drained soils in the study area have water tables between 1 to 2 meters of the surface during the growing season and hence lower effective soil water deficit. Precipitation during the growing season commonly contributes between 59 and 73 percent of the water requirements of regionally adapted crops like cereal grains.

Table 4. Soil-Climatic Analysis of Soil Temperature Sites in South-Central Manitoba.

Site, Location and Soil Name and texture	Depth cm	Soil Temp. °C		Day of year when soil temperature is:					
				Date 0°C		Date 5°C		Date 15°C	
		Mean Annual	Mean Summer	Spring	Fall-Winter	Spring	Fall-Winter	Spring	Fall
a) Manitou	20	6.2	14.9	100*	342	114	310	184	240
NW 02-04-08W	50	5.9	13.2	093*	354	122	316		
(Manitou CL, treed)	100	6.1	10.6	078*	040	133	336		
	150	6.3	9.1			137	354		
b) Notre Dame	20	6.5	14.4	111*	353	117	318	193	242
NE 14-07-09W	50	6.4	12.9	107*	004	124	327		
(Pembina CL, treed)	100	6.3	10.6	104*	046	136	343		
	150	6.2	10.2			139	344		
c) Elm Creek	50	6.7	15.4	120	103	134	309	190	247
SE 26-07-05W	100	6.9	14.2	131	109	137	321	213	244
(Willowcrest LFS, cultivated)	150	6.8	11.3			145	354		
	200	7.3	9.5			155	037		
d) Miami	20	6.5	16.4	112*	343	119	316	173	262
SE 31-05-06W	50	6.8	14.6	114*	361	124	328	191	261
(Neuenberg L, grassed)	100	7.2	12.2	115*	037	133	349		
	150	7.3	10.7			138	363		
e) Graysville	20	7.2	18.6	112*	336	109	311	156	264
SE 24-06-06W	50	7.3	16.4	125*	355	119	325	175	269
(Reinland LFS , cultivated)	100	6.7	12.3	133*	019	140	345	223	261
	150	6.8	10.4	137*	049	150	362		
f) St. Claude	20	7.8	18.6	103*	338	101	311	152	261
NW 02-08-07W	50	7.8	16.9	116*	355	109	322	167	264
(Reinland LFS, cultivated)	100	7.7	13.9	123*	025	122	342	202	261
	150	7.6	11.8			128	357		
g) Starbuck	20	7.8	16.7	093*	352	102	317	164	254
SE 27-09-01W	50	7.7	14.8	094*	011	111	330	188	252
(Red River C, grassed)	100	7.6	12.1			125	355		
	150	7.6	9.8			137	382		
h) Glenlea Lot 6	50	5.1	12.7	121	351	136	309	194	260
(Osborne C, cultivated)	100	4.7	8.5	142	037	164	336		
	150	4.9	5.4	132	090	195	003		
	200	5.2	3.4	124	114	208	067		

* Date estimated from graphed data.

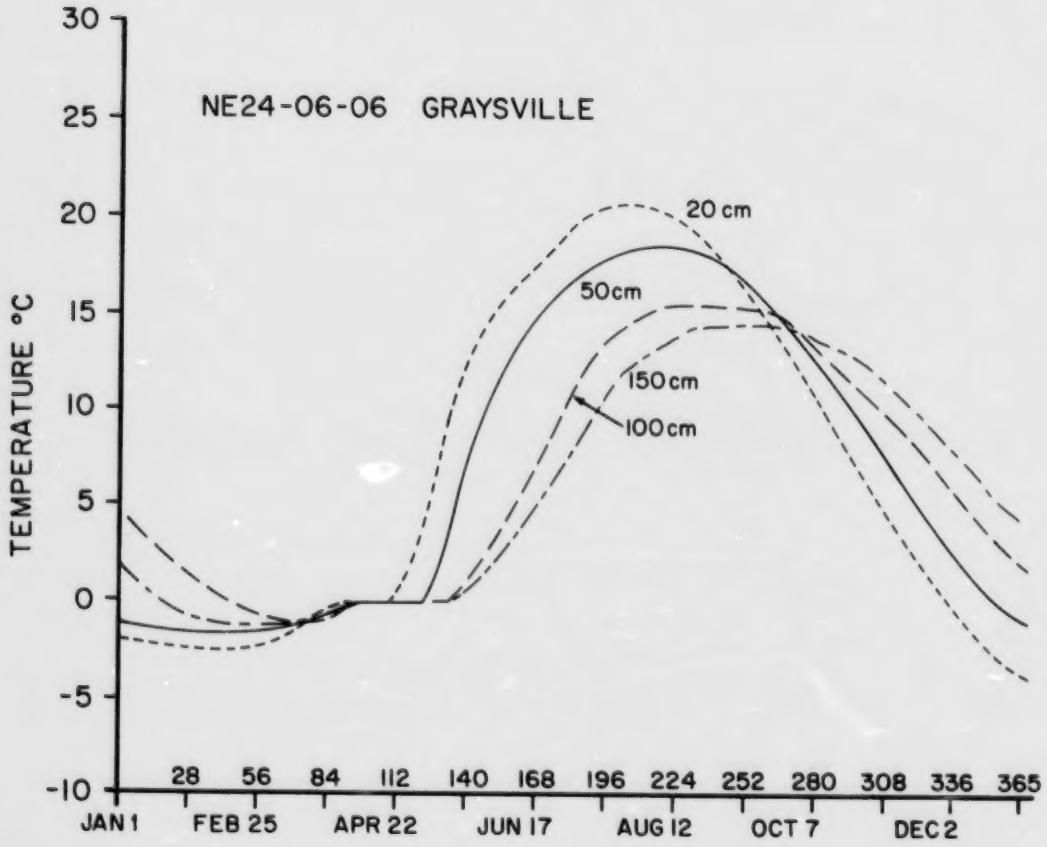


Figure 5: Seasonal soil Temperature Data for Cultivated Reinland Series at Graysville.

2.6 VEGETATION

The portion of the study area above the Escarpment occurs in the Aspen-Oak Section of the Boreal Forest Region whereas the area below the Escarpment is part of the Grasslands (Rowe, 1972). As most of the study area is cultivated, natural vegetation is restricted to the steeply sloping and dissected areas of the Escarpment, steeper slopes associated with hummocky to hilly moraine west of the Escarpment, level to depressional areas with poor drainage and portions of flood plains and river levees subject to frequent flooding.

Wooded areas of the Pembina Hills consist of near continuous cover of mixed deciduous forest. Forest stands are dominantly aspen with inclusions of oak, Manitoba maple and cottonwood. Balsam poplar and willow become dominant on the lower slopes. Well drained sites include shrubs such as hazel, chokecherry and dogwood whereas on lower slopes willow and dogwood are more common. Mixtures of grasses and low forbs form the ground cover. Level to depressional poorly drained areas are usually treeless with vegetation consisting of sedges, reeds and meadow grasses.

The upper slopes of the Pembina Escarpment are dominantly wooded with the same species as found within the Pembina Hills. Alluvial fans along the lower slope of the Escarpment support hardwood forest of elm, maple, ash and oak on better drained portions of the fan and along stream levees; areas prone to more frequent flooding and ponding have a understory of dominantly meadow grasses and sedge.

Native vegetation within the Manitou Plain is dominantly tall prairie grasses and herbs with scattered groves of aspen, oak and green ash. Oak is more dominant on prominant knolls where the shale is close to the surface. Most of the area is presently under cultivation.

Native vegetation within the Red River Valley is dominantly mixed tall prairie grasses, meadow prairie grasses and herbs. Groves of oak, elm, maple and ash occur along many of the better developed streams and creeks throughout the area; areas prone to frequent flooding and ponding have an understory of dominantly meadow grasses and sedge.

Native vegetation within the lower Assiniboine Delta consists of mixed prairie grasses and groves of mixed deciduous trees. On level to gently sloping land the dominant vegetation consists of aspen with some willow, saskatoon, chokecherry and hazel. On duned landscapes, the vegetation consists of bur oak, with a sparse ground cover of grass, artemisia, cactus and juniper. Vegetation on the level to depressional parts of the landscape which are influenced by wetness for a considerable part of the year consist of willow, sedges, cattails, other meadow grasses and herbaceous plants.

2.7 ECOCLIMATIC REGIONS AND SUBREGIONS

The relationships existing among climate, vegetation and soil in southern Manitoba are summarized in the ecological zonation shown in Figure 6. This zonation is described in terms of broadly defined units called Ecoclimatic Regions. Such regions usually cover a continuous geographic area and are characterized by distinctive ecological responses to macro-climate as expressed by vegetation, soil, fauna and aquatic systems.

Ecoclimatic Region[1]	Sub-region[2]	Dominant Soils	Soil Climate		Vegetation Zone
			Temperature Class	Moisture Subclass	
GRASSLAND TRANSITION	Gt 1,2,3,4	Chernozemic Black, Gleysols	Boreal, cool to moderately cool	Subhumid	Grassland and Aspen Parkland
LOW BOREAL subhumid	LBs 1,2	Chernozemic Dark Gray, Brunisolic, Organic	Cryoboreal, moderately cold	Subhumid	Grassland-forest transition
LOW BOREAL, subhumid transition		Brunisols, Luvisols Chernozemic Dark Gray, Gleysols, Organic	Cryoboreal, moderately cold	Humid to subhumid	Mixed Deciduous - Coniferous Forest
MID BOREAL, subhumid	MBs 1,2, 3,4	Luvisolic, Brunisols, Organic	Cryoboreal, moderately cold	Subhumid to humid	Mixed Deciduous -Coniferous Forest

[1] Ecoclimatic Regions of Manitoba. Canada-Manitoba Soil Survey, 1985. Unpublished data, revised, 1987.

[2] Subregions reflect climatic influence which is expressed in local soil and vegetation relations and which affect land use, management and potential biomass production.

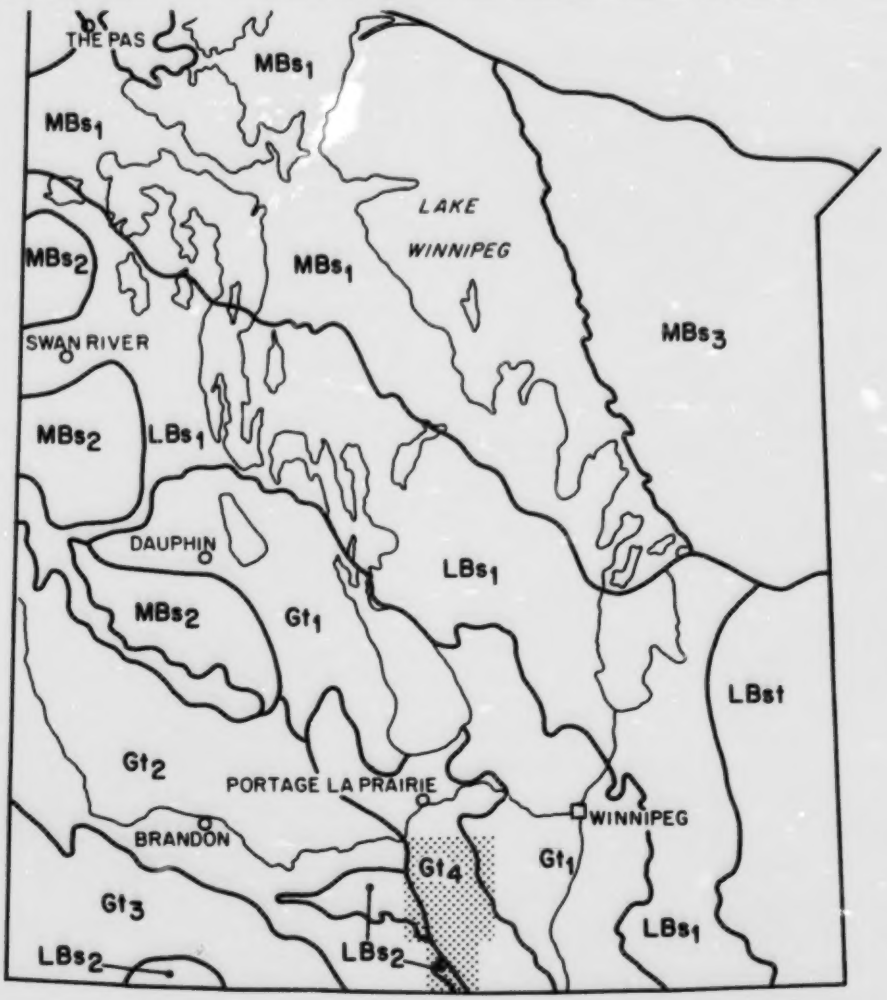


Figure 6: Ecoclimatic Regions and Subregions in southern Manitoba.

A specific ecoclimatic region is distinguished usually by one or more associations of soils and plants which differ in terms of ecologic properties or proportionate extent from the associations of adjacent regions. The change in regional climate in different regions usually alters site conditions sufficiently to result in development of different soil associations and vegetation types. Soil types developed on similar parent material and under similar drainage conditions but in different ecoclimatic regions are identified by different series or association names to indicate that many of the associated ecologic conditions are dissimilar.

The study area is characterized by climate, soil and vegetation conditions typical of the Grassland Transition (Gt) and Low Boreal Subhumid ecoclimatic regions. Selected climatic data from the study area are presented in Table 3. Associated ecologic characteristics are summarized in the Legend for Figure 6 and the ecologic relations and trends between the various regions and subregions are described as follows.

The Grassland Transition Ecoclimatic Region occupies the majority of the study area. The cool subhumid climate of this region provides sufficient moisture and length of growing season for persistence of dominantly native grassland vegetation and Chernozemic Black soils.

Three subregions of the Grassland Transition Ecoclimatic region occur in the study area recognizing slight but significant shifts in prevailing temperature and moisture conditions. The Gt2 subregion occurs above the Manitoba Escarpment and is affected by slightly cooler and drier climatic conditions than those prevailing in the Gt4 subregion below the Escarpment. The combination of soil and climatic conditions in the Gt4 subregion results in the most favourable growing conditions for cereal production and special crops. The Gt1 subregion is of limited extent in the eastern portion of the study area. Soil temperatures are slightly lower in this subregion due to the heavy clay soils and generally poor drainage. In addition growing degree days and frost free season are slightly less favourable than those encountered in the Gt4 subregion.

Ecologic conditions representing the Low Boreal Subhumid Ecoclimatic Region in the study area occur on the higher elevation of the Pembina Hills. Slightly cooler temperatures at these elevations results in higher moisture effectiveness and development of near-continuous deciduous forest and strongly leached Dark Gray Luvisol soils.

Because climatic change from one Ecoclimatic Region to another has such importance to the ecology of an area, the region boundaries provide a useful basis for recognizing soil series and associations. Soil types developed on similar parent material and drainage conditions but in different ecoclimatic regions are given different series or association names to indicate that many of the associated ecologic conditions are dissimilar. Soils in each ecoclimatic region occur under climatic conditions which influence not only the soil thermal and moisture regime but also the various ecological and physical activities or weathering processes whereby rocks, minerals and organic matter are broken down to become soil material (See Part 3, Section on Soil Development).

PART 3

DEVELOPMENT, CLASSIFICATION AND DESCRIPTION OF SOILS

This section describes soil development in the study area and the system of soil classification used to classify and describe the soils. The application of the soil classification to soil mapping is described and finally each soil series recognized in the survey area is described in detail.

3.1 SOIL DEVELOPMENT

Soil development on the various parent materials in the study area is influenced by the regional climate, soil drainage and groundwater hydrology. Soils in the study area occur dominantly in the Grassland Transition Ecoclimatic Region and have developed under cool subhumid climatic conditions which generally provide sufficient moisture and length of growing season for persistence of dominantly native grassland vegetation. Well to imperfectly drained sites are often interspersed with aspen groves. This vegetation and climate have resulted in a dominance of Chernozemic Black soils. Better drained sites under grass vegetation show evidence of leaching and the development of Orthic Black profiles with dark coloured Ah horizons and brown B horizons. Imperfectly drained soils are characterized by Rego Black profiles with dark coloured Ah horizons underlain by calcareous parent material. Poorly drained sites are characterized by sedge and reed vegetation often associated with clumps of willow.

Humic Gleysol soils found in association with poorly drained areas also have dark coloured Ah horizon which grade into dull coloured mottled parent material. Profile development of the imperfectly and poorly drained soil types has been restricted by soil moisture regime and proximity of groundwater to the soil surface. Soil development along creeks and rivers has been influenced by periodic flooding and accretion of sediments on the soil surface. The resulting Regosol soils have little or no horizon development.

The Pembina Hills area above the Manitoba Escarpment is characterized by subregional climate and associated vegetation and soils representative of the Low Boreal Subhumid Ecoclimatic Region. At highest elevations of this hummocky upland, slightly cooler temperatures result in a slight increase in available moisture, near continuous deciduous forest and development of strongly leached Dark Gray Luvisol soils on well drained sites.

Undulating and gently sloping landscapes at lower elevation are characterized by areas of transitional grassland-forest and dominantly Chernozemic Dark Gray and Gleyed Dark Gray soils. Poorly and very poorly drained depressions throughout the subregion are characterized by Luvic Humic Gleysols and Rego Humic Gleysols. These sites are commonly treeless supporting hydrophytic stands and wet meadow grass and sedge with clumps of willow. Very poorly

drained depressions support marsh vegetation comprised of reeds and rushes. Cultivated areas with steeply sloping topography are often severely eroded and the resulting soils are generally Regosols or regosolic subgroups of Dark Gray Luvisol or Chernozemic soil types.

3.2 SOIL CLASSIFICATION

Interaction of the soil forming factors described in Part 2 have resulted in development of individual soil types with distinctive morphology and properties that form the bases for their classification. Soils in the study area were classified according to the System of Soil Classification for Canada (Agriculture Canada, 1987). This system is hierarchical employing 5 levels of generalization or categories of classification. The classification is based on measurable soil properties that can be observed in the soil profile or can be inferred from other properties observable in the field.

A soil profile is the sequence of natural layers or horizons observed in vertical cross-section extending from the surface down into the relatively unweathered and unaltered soil parent material. The main or master horizons have been designated by the letters A, B and C for mineral horizons. Horizon characteristics and combinations of these horizons form the basis for soil classification. The A and B horizons are a reflection of the active soil forming factors, climate and plant and animal life, chiefly plants operating on the parent material. Together the A and B horizons make up the solum. In general, A horizons or surface layers are subjected to the greatest amount of weathering and leaching and/or organic matter accumulation. The B horizons, lying immediately below the A horizon contain most of the material leached from the A horizons ie. clay, organic matter or iron and aluminum. In some soils, B horizons consist mainly of material that has been altered only slightly by soil forming processes, but has not been translocated. The C horizons represent the relatively unaltered parent material from which the solum has developed.

The five levels of generalization employed to classify the soils in this study are defined as follows:

ORDER - Soil orders are defined on the basis of soil properties that reflect the soil environment and the kind and degree of dominant soil forming process. An example is Chernozem in which soils with dark coloured surface horizons develop under subhumid climate and dominantly grassland environments.

GREAT GROUP - Each order is subdivided into great groups based on differences in strength of dominant processes or a major contribution of a process in addition to a dominant one. Such processes result in particular kinds, arrangement and degree of expressions of pedogenic horizons. An example is a Luvic Gleysol in which the dominant process is considered to be gleying but clay accumulation in the B horizon is also a major process.

SUBGROUP - Subgroups are subdivisions of great groups and are defined on the basis of kind and arrangement of horizons that indicate the central concept of the great group Orthic; intergrades toward soils in other orders, Gleyed, or special features such as lime carbonate in B horizons.

FAMILY - Familes are established within a subgroup based on similarity of physical and chemical properties that affect management. Among the properties considered important for recognizing families are particle

size distribution, mineralogy, soil climate, soil reaction and thickness of solum.

SERIES - The series consists of soils that formed in a particular kind of material and have horizons whose color, texture, structure, consistence, thickness, reaction and chemical composition are similar in differentiating characteristics and in arrangement in the soil profile.

3.3 APPLICATION OF SOIL CLASSIFICATION TO SOIL MAPPING

Soil classification provides sets of parameters defined in terms of broad limits for the upper categories (Order and Great Group) to increasingly narrow limits on progressing to the lower categories (Subgroup, Family and Series). The soils in this survey area are classified according to nationwide uniform procedures. Each soil can be classified according to any category of the system but the soil series is the category of soil classification most used in a local survey. Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement and other important characteristics. Each soil series is named after a town or geographic feature near the place where a soil of that series was first observed and mapped. Darlingford and Almasippi, for example, are the names of two soil series. All the soils in Manitoba having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in degree of erosion slope, stoniness, salinity, or some other characteristic that affects use of the soils by man. Poorly drained soils in the study area may have thin peaty surface layers. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Altamont clay loam, 1 to 3 percent slopes is one of several phases within the Altamont Series. The peaty surface layer on some poorly drained soils is recognized by P placed after the series symbol. The class definitions and use of these phases is described in the section on Soil Map Unit.

Very often it is desirable to recognize minor variation in certain soil properties or landscape features that deviate from the normal. These variants or phases of soil series have properties which are sufficiently different from other known soils to justify a new series name, but because their known extent is of limited geographic area, creation of a new series is not justified. A soil series variant is named after the soil it most closely resembles, as well as the feature which distinguishes it from the named soil (eg. Pembina 1, is a soil profile displaying the characteristics defined by the Pembina series but in addition having a VFSL-SiL textured glaciolacustrine substrate within a meter of the soil surface).

3.4 SOIL MAP UNITS

The areas shown on a soil map are called soil map units. Some map units are made up of one kind of soil (simple map unit); others are made up of two or more kinds of soil (compound map unit). A soil map unit represents an area on the landscape and consists mostly of the soil or soils for which the unit is named. Most map units include small, scat-

tered areas of soils other than those that appear in the name of the map unit. Some of these soils may have properties very similar to the dominant soil or soils, whereas other soil inclusions have properties that differ substantially from those of the dominant soil and thus could significantly affect use and management of the map unit. In such compound map units, the dominant, subdominant and minor (if substantially different) soil series are identified and their decile proportions within each map unit delineation is specified. A user of the soil survey must refer to two or more named soils in the map legend and soil report to obtain a complete description of a compound map unit.

A variation of the compound map unit, the complex map unit, contains two or more named or unnamed soils and non-soils which occur in unspecified proportions. This map unit occurs where soil variability is so complex and unpredictable that soils cannot be delineated separately, nor can their relative proportions be estimated. Although these soils are related geographically they cannot be delineated separately because of the intricacy of soil pattern, the cartographic limitation of map scale or survey intensity. A user will need only to refer to one map unit name in the soil legend and soil report to obtain as complete a description as is possible of the soil complex.

Very often, it is desirable to indicate by map unit symbol, variation in certain intrinsic properties of soils or landscape features that deviate from the normal. These variants or phases of series usually affect soil management. In this study, the effect of four such properties and features are indicated. These are erosion, slope class, degree of stoniness and salinity. The degree or magnitude of each is designated in the following manner:

Erosion

- x - none-eroded or minimal
- 1 - weakly eroded
- 2 - moderately eroded
- 3 - severely eroded
- 0 - overblown

Slope Class

- x - 0 to 2% level to nearly level
- c - 2 to 5% very gently sloping
- d - 5 to 9% gently sloping
- e - 9 to 15% moderately sloping
- f - 15 to 30% strongly sloping
- g - 30 to 45% very strongly sloping
- h - 45 to 70% extremely sloping

Stoniness

- x - non stony
- 1 - slightly stony
- 2 - moderately stony
- 3 - very stony
- 4 - exceedingly stony
- 5 - excessively stony

Salinity

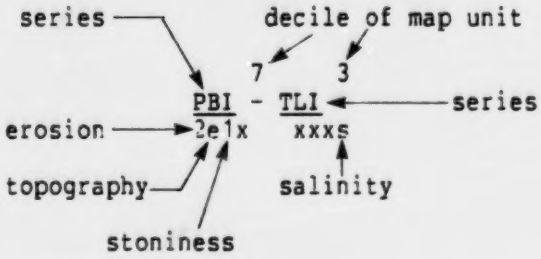
- x - non saline (0-4 mS/cm)
- s - weakly saline (4-8 mS/cm)
- t - moderately saline (8-15 mS/cm)
- u - strongly saline (>15 mS/cm)

The convention employed to indicate these features in the map symbol is as follows:

If all of the above properties are observed to be minimal, the map symbol representing soil series is used alone without modifiers. If one or more phase features are recognized, the appropriate letter or number is placed below the soil series symbol in one of four designated locations in the map unit symbol. The designated order is erosion, slope class, stoniness and salinity. If a particular feature is observed to be minimal, an x is used in its appropriate

designated location in the map symbol.

For example, the compound map unit coded as follows:



Is interpreted to mean that an estimated 70 percent of this compound map unit contains Pembina soils (PBI) on moderately eroded (2), 9 to 15 percent slopes (e) which are slightly stony (1); and approximately 30 percent of the map unit is weakly saline(s) Tellier soils on level, non-eroded, non-stony land.

3.5 GENERALIZED SOIL MAP

A generalized soil map and legend are included in Appendix E of this publication showing map units for broad land-use planning in the study area. Each map unit is a unique, natural landscape that has a distinct pattern of soils and of relief and drainage features. A unit typically consists of one or more soils of major extent and some soils of minor extent. The map units are named according to the dominant and significant soil series identified in the area on the detailed soil map. Soil phases, minor components of compound map units and soil inclusions are not recognized on the generalized soil map.

The generalized soil map provides an overview of the soil distribution and the landscapes in the map area. It provides a basis for comparing the potential of large areas for general kinds of land use. This information is useful for broad-scale planning, for identifying areas suitable for certain kinds of farming or other land uses. Similarly, areas of soils with properties that are distinctly unfavourable for certain land uses can be located.

The generalized soil map, because of its small scale does not show the kind of soil at a specific site. Therefore it is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other kind of infrostructure. The kinds of soils in any one map unit ordinarily differ from place to place in slope, depth, stoniness, drainage or other characteristic that affect their management.

A brief description of each generalized soil group is included in Appendix E.

3.6 DESCRIPTION OF SOIL SERIES

Soil parent material and soil moisture regime characteristics have a major influence on soil profile type and so become the major features used in classifying and mapping soils. The relationship of parent material and drainage to soil profile type (genetic subgroup) and soil series in the study area is shown in the key to soils (Table 5). A convenient, abbreviated summary of these relationships and the soil series recognized within major areas of similar physiographic and climatic conditions is presented in Table 6. The soils recognized in Ecoclimatic Regions Gt2 and LBs2 are summarized in Table 6a; soils recognized in Ecoclimatic Regions Gt1 and Gt4 are shown in Table 6b.

Generalized descriptions for each soil series mapped in the survey area are presented in alphabetic order. Characteristics of the soil and the material in which it formed including extent of the soil, genetic profile type, texture, parent material type, topography and drainage are discussed for each series. The soil is compared to similar soils and to nearby soils of other series. Following this, the range of important characteristics of the soil series in the survey area is presented. A brief description of the features which distinguish the named soil from similar soils is included. The generalized soil descriptions are based on summaries and averages of soil data systematically documented and recorded during the course of the field survey.

Information on the suitability and management requirement of each soil for various agricultural and nonagricultural uses is presented in Part 4 of this report.

TABLE 5

Soil Key for the Grey, Dufferin, Roland, Thompson and Stanley Municipalities arranged according to parent material, drainage and series (Canada Soil Survey Committee)

	Map Symbol	Eco-climatic
1. Soils developed on deep (>100 cm) moderately to very strongly calcareous loamy (loam to clay loam) galcial till of shale, limestone and granitic origin.		
a) Well drained		
• Darlingford Series (Orthic Black)	DGF	Gt2
• Hebbot Series (Rego Black)	HEB	Gt2
• Worden Series (Orthic Regosol)	WOR	Gt2
• Dezwood Series (Orthic Dark Gray)	DZW	LBs
• Pembina Series (Dark Gray Luvisol)	PBI	LBs
• Poyser Series (Orthic Gray Luvisol)	PYR	LBs
• Denton Series (Orthic Regosol)	DET	LBs
b) Imperfectly drained		
• Ferris Series (Gleyed Rego Black, carbonated)	FRS	Gt2
• Nikkel Series (Gleyed Black)	NKK	Gt2
• Zaplin Series (Gleyed Dark Gray)	ZPI	LBs
c) Poorly drained		
• Cazlake Series (Rego Humic Gleysol)	CZK	Gt2
• Horose Series (Rego Humic Gleysol)	HOS	LBs
• Pouchal Series (Humic Luvic Gleysol)	POU	LBs
2. Soils developed on a thin veneer (25 to 90 cm) of dominantly loamy fluvial or lacustrine sediments overlying moderately to		

very strongly calcareous waterworked glacial till; shale bedrock may be present at depth of 1-1.5 m below the surface. A thin (<10 cm) gravelly lense may occur at the contact of the overlay and till. Where shale bedrock occurs near the surface, soils may be saline.

a) Well drained

• Roseisle Series (Orthic Black)	RSI	Gt4

b) Imperfectly drained

• Glencross Series (Gleyed Rego Black)	GCS	Gt4
• Nanton Series (Gleyed Black)	NTO	Gt4

c) Poorly drained

• Boxner Series (Rego Humic Gleysol)	BOX	Gt4

3. Soil developed on a thin veneer (25 to 90 cm) of dominantly fine loamy, weakly to moderately calcareous lacustrine sediments overlying moderately to very strongly calcareous glacial till of shale, limestone and granitic origin.

a) Well drained

• Knudson Series (Orthic Black)	KUD	Gt2
• Altamont Series (Orthic Dark Gray)	ATN	LBs
• Kingsley Series (Dark Gray Luvisol)	KIS	LBs

b) Imperfectly drained

• Joyale Series (Gleyed Rego Black)	JYL	Gt2
• Ullrich Series (Gleyed Black)	ULH	Gt2
• Tellier Series (Gleyed Dark Gray)	TLI	LBs
• Zinman Series (Gleyed Solonetzic Dark Gray)	ZIM	LBs

c) Poorly drained

• Guerra Series (Rego Humic Gleysol)	GRR	Gt2

• Narish Series (Rego Humic Gleysol)	NSH	LBs
• Watrine Series (Humic Luvic Gleysol)	WTI	LBs

4. Soils developed on a variable veneer (25-90 cm) of moderately to very strongly calcareous loamy (L, CL, SiCL) glacial till of shale, limestone and granitic origin overlying non - to weakly calcareous shale bedrock.

a) Well drained

• Froswick Series (Orthic Black)	FWK	Gt4
• Oakley Series (Orthic Dark Gray)	OAY	LBs

b) Imperfectly drained

• Jirose (Gleyed Rego Black, carbonated)	JIS	Gt2

5. Soils developed on a veneer (25-90 cm) of non to weakly calcareous clayey deposits or weathered (softened) shale overlying non - to weakly calcareous shale bedrock.

a) Well to moderately well

• Brundis Series (Orthic Black)	BNI	Gt4
• Benton Series (Solonetzic Dark Gray)	BEO	LBs

b) Imperfectly drained

• Klidal Series (Gleyed Solonetzic Black)	KDA	Gt4
• Bishop Series (Gleyed Rego Black (carbonated)	BIP	Gt4

6. Soils developed on non to weakly calcareous fine loamy, variable lacustrine and till deposits derived dominantly from cretaceous shales; these deposits may be underlain by weathered shale or shale bedrock within 1 to 1.5 m; soils with shallow deposits of till or fragmental altered shale over bedrock are also included.*

a) Well drained

• Stallar Series* (Orthic Regosol)	SXG	LBs
• Manitou Series (Orthic Black)	MXS	Gt2
• Fifere Series (Orthic Dark Gray)	FFR	LBs
• Nayler Series (Dark Gray Luvisol)	NYO	LBs
b) Imperfectly drained		
• Nowell Series (Gleyed Black)	NOW	Gt2
• Fresno Series (Gleyed Dark Gray)	FSO	LBs
7. Soils developed on deep (>100 cm) moderately to strongly calcareous, stratified medium sand to gravelly fluvial outwash or beach deposits with shale, limestone and granitic fragments (above the Escarpment and transition).		
a) Well drained		
• Marringhurst (Calcareous Black)	MRH	Gt2
b) Imperfectly drained		
• Mansfield Series (Gleyed Rego Black)	MFI	Gt2
c) Poorly drained		
• Fortina Series (Rego Humic Gleysol)	FTN	Gt2
8. Soils developed on deep (>100 cm) moderately to strongly calcareous, stratified sandy to gravelly fluvial outwash deposits of limestone and granitic materials (along the Escarpment and Lake Agassiz Basin).		
a) Well drained		
• Leary Series (Orthic Dark Gray)	LRY	LBs
• Agassiz Series (Orthic Black)	ASZ	Gt4
• Birkenhead Series (Calcareous Black)	BKA	Gt4
9. Soils developed on a thin mantle (25 to 90 cm) of moderately to strongly calcareous, fine loamy (L, SCL, SiCL, CL) sediments overlying moderately to strongly calcareous, sandy and gravelly deposits (within and above the Escarpment).		

a) Well drained

• Croyon Series (Orthic Black)	CYN	Gt2

b) Imperfectly drained

• Capell Series (Gleyed Rego Black)	CXT	Gt2
• Druxman Series (Gleyed Black)	DXM	Gt2

c) Poorly drained

• Carvey Series (Rego Humic Gleysol)	CAV	Gt2

10. Soils developed on thin veneer (25-90 cm) of moderately to strongly calcareous coarse loamy (VFS, LVFS, FSL, VFSL, L, SiL) sediment overlying moderately to strongly calcareous stratified sandy, and gravelly deposits (along and above the Escarpment in association with Leary and Pembina soils).

a) Well drained

• Vandal Series (Orthic Dark Gray)	VDL	LBs
• Trinton Series (Dark Gray Luvisol)	TNT	LBs

b) Imperfectly drained

• Vartel Series (Gleyed Dark Gray)	VTL	LBs

c) Poorly drained

• Yustak Series (Rego Humic Gleysol)	YTK	LBs

11. Soils developed on moderately to strongly calcareous, stratified, dominantly loamy (LVFS, SL, L, SiL, SiCL, CL textural class) recent alluvial deposits (above Escarpment).

a) Moderately well to well drained

• Mowbray Series (Cumulic Regosol)	MOW	Gt2

b) Imperfectly drained

• Levine Series (Gleyed Cumulic Regosol)	LEI	Gt2

c) Poorly drained

• Basker Series (Rego Humic Gleysol)	BKR	Gt2

12. Soils developed on steeply sloping lands along escarpments, creeks and ravines that have been influenced by erosion, and mass wasting processes.

• Eroded Slopes Complex	ERX	LBs
• Tredwell Series (Rego Humic Gleysol)	TDW	LBs

13. Soils developed on fine to very fine clayey (C, HC), moderately to strongly calcareous lacustrine sediments.

a) Moderately well to well drained

• Myrtle Series (Orthic Black)	MYT	Gt1

b) Imperfectly drained

• Red River Series (Gleyed Rego Black)	RIV	Gt1
• Scanterbury Series (Gleyed Black)	SCY	Gt1
• Morris Series (Gleyed Solonetzic Black)	MRS	Gt1

c) Poorly drained

• Osborne Series (Rego Humic Gleysol)	OBO	Gt1,4

14. Soils developed on dominantly clayey, stratified, moderately to strongly calcareous, fluvial and lacustrine sediments. This group includes the soils * on the very fine clayey, variable saline sediments adjacent to the Pembina Escarpment and may be underlain by altered shale, bedrock, till or stratified sediments; seepage and salinity are common.

a) Moderately well drained

• Winkler Series (Orthic Black)	WIK	Gt4
• Winkler*, very fine clayey variant	WIK2	Gt4

b) Imperfectly drained

• Plum Coulee Series (Gleyed Black)	PME	Gt4
• Deadhorse Series (Gleyed Rego Black)	DHO	Gt4
• Fortier Series (Gleyed Cumulic Regosol)	FTE	Gt4
• Gretna Series* (Gleyed Solonetzic Black-Gleyed Rego Black)	GRA	Gt4
• Blumengart Series* (Gleyed Cumulic Regosol)	BMG	Gt4
c) Poorly drained		
• Blumenort Series* (Rego Humic Gleysol, carbonated)	BUM	Gt4
15. Soils developed on moderately to strongly calcareous clayey (SC, C, SiC) fluvial and lacustrine sediments (up to 90 cm) grading to moderately calcareous, dominantly (LFS, FS) sediments or with coarse loamy strata (VFS, LVFS, FSL) sediments.		
a) Moderately well drained		
• Jordan Series (Orthic Black)	JOD	Gt4
b) Imperfectly drained		
• Horndean Series (Gleyed Black)	HND	Gt4
• Dugas Series (Gleyed Rego Black)	DGS	Gt4
16. Soils developed on dominantly fine loamy (SCL, CL, SiCL) moderately to strongly calcareous fluvial and lacustrine sediments.		
a) Moderately well drained		
• Eigenhof Series (Orthic Black)	EGF	Gt4
b) Imperfectly drained		
• Neuhorst Series (Gleyed Rego Black)	NUH	Gt4
• Rathwell Series (Gleyed Black)	RWL	Gt4
17. Soils developed on dominantly loamy (VFSL, L, SiL) stratified moderately to strongly calcareous fluvial and lacustrine sedi-		

ments, subsoil textures within and below 1 m include finer strata of (SiCL and CL) texture.

a) Moderately well drained

• Reinfeld Series (Orthic Black)	RFD	Gt4

b) Imperfectly drained

• Gnadenthal Series (Gleyed Rego Black, carbonated)	GDH	Gt4

c) Poorly drained

• Blumenfeld Series (Rego Humic Gleysol)	BNF	Gt4

18. Soils developed on moderately to strongly calcareous loamy (L, SiL, CL, SCL, SiCL, VFSL) fluvial and lacustrine sediments overlying calcareous lacustrine clay.

a) Moderately well drained

• Denham Series (Orthic Black)	DNH	Gt4

b) Imperfectly drained

• Graysville Series (Gleyed Rego Black, carbonated)	GYV	Gt4
• Rignold Series (Gleyed Black)	RGD	Gt4
• Pigeon Lake Series (Gleyed Cumulic Regosol)	PGK	Gt4

c) Poorly drained

• Edkins Series (Rego Humic Gleysol)	EDK	Gt4

19. Soils developed on moderately to strongly calcareous, loamy (VFSL, SiL, L) fluvial and lacustrine sediments grading to moderately calcareous, sandy sediments.

a) Moderately well drained

• Rosengart Series (Orthic Black)	RSG	Gt4

b) Imperfectly drained

• Neuenberg Series (Gleyed Rego Black, carbonated)	NBG	Gt4
• Jasset Series (Gleyed Black)	JST	Gt4

20. Soils developed on moderately to strongly calcareous, fine loamy (SCL, CL, SiCL) fluvial and lacustrine sediment grading to moderately calcareous, dominantly sandy (LFS, FS) sediments or with coarse loamy strata (VFS, LVFS, FSL) sediments.

a) Moderately well drained

• Edenburg Series (Orthic Black)	EBG	Gt4

b) Imperfectly drained

• Newton Siding Series (Gleyed Rego Black)	NWN	Gt4

21. Soils developed on coarse loamy (LVFS, VFS, FSL) grading to sandy (LFS, FS) moderately calcareous deltaic and lacustrine sediments.

a) Moderately well drained

• Hochfeld Series (Orthic Black)	HHF	Gt4

b) Imperfectly drained

• Reinland Series (Gleyed Rego Black, carbonated)	RLD	Gt4
• Kronstal Series (Gleyed Black)	KOT	Gt4

c) Poorly drained

• Osterwick Series (Rego Humic Gleysol)	OWK	Gt4

22. Soils developed on weakly to moderately calcareous sandy (LFS, FS) lacustrine and fluvial sediments and includes surface wind-modified (aeolian) deposits. Associated very strongly, carbonated soils (*) are also included.

a) Well drained

• Aronet Series (Cumulic Regosol)	ARN	Gt4

• Dobbin Series (Orthic Dark Gray)	DOB	Gt4,2
• Skelding Series (Orthic Regosol)	SKL	Gt4
• Stockton Series (Orthic Black)	SCK	Gt4,2
b) Imperfectly drained		
• Willowcrest Series (Gleyed Black)	WWC	Gt4
• Almasippi Series (Gleyed Rego Black, carbonated)	ASS	Gt4
• Long Plain Series (Gleyed Regosol)	LOP	Gt4
• St. Claude Series* (Gleyed Rego Black, carbonated)	SUE	Gt4
c) Poorly drained		
• Lelant Series (Rego Humic Gleysol)	LLT	Gt4
23. Soils developed on moderately to strongly calcareous sandy (FS, LFS) to coarse loamy (VFS, LVFS, FSL) fluvial and lacustrine sediments overlying calcareous lacustrine clay.		
a) Moderately well drained		
• Hibsin Series (Orthic Black)	HIN	Gt4
b) Imperfectly drained		
• Elm Creek Series (Gleyed Black)	EEK	Gt4
• Rosebank Series (Gleyed Rego Black, carbonated)	RBK	Gt4
c) Poorly drained		
• Layland Series (Rego Humic Gleysol)	LAY	Gt4
24. Soils developed on moderately to strongly calcareous, stratified dominantly loamy (VFSL, L, SiL, SiCL, CL textural class) recent fluvial deposits of the Boyne River and Assiniboine Rivers.		
a) Moderately well drained		
• La Salle Series (Cumulic Regosol)	LSL	Gt4

b) Imperfectly drained

• Gervais Series (Gleyed Cumulic Regosol)	GVS	Gt4
• Poplar Point (Gleyed Cumulic Regosol)	PPR	Gt4

c) Poorly drained

• Willowbend Series (Rego Humic Gleysol)	WWB	Gt4

25. Soils developed on loamy (VFSL, L, SiL, SiCL, CL) moderately to strongly calcareous, recent fluvial sediments overlying clayey (SiC, C, HC) lacustrine deposits.

a) Imperfectly drained

• Pigeon Lake Series (Gleyed Cumulic Regosol)	PGK	Gt4

26. Soils developed on dominantly loamy fluvial deposits from the shales and till of the Escarpment with evidence of recent deposition.

a) Imperfectly drained

• Chortitz Series (Gleyed Cumulic Regosol)	CTZ	Gt4

b) Poorly drained

• Loewen Series (Rego Humic Gleysol)	LEW	Gt4

27. Soils developed on dominantly clayey fluvial deposits from the shales and tills above the Escarpment with evidence of recent deposition.

a) Poorly drained

• Kerran Series (Rego Humic Gleysol)	KRN	LBs,Gt2

28. Organic soils developed on thin (40-130 cm) dominantly fennic moderately decomposed peat, overlying sandy (or loamy*) fluvial and lacustrine sediments.

• Perillo Series(Terric Mesisol)	PER	Gt4

• Perillo, loamy substrata*	PER1	Gt4,2
29. Organic soils developed on thick (>130 cm) dominantly fennic, moderately decomposed peat.		
• Xavier Series (Typic Mesisol)	XVI	Gt4,2

Table 6a Relationship of the Soil Series in the Gt2 and LBs2 Subregions in Report D60 to

Soil Drainage	Eco-Sub-region	Taxonomic Classification Subgroup	Parent Materials			
			Till			
			Loamy, Mixed calcareous /shale brk.		Loamy, shaly	Venee or al /shal
Well to Moderately Well	Gt2	Cumulic Regosol				
		Orthic Black	Darlingford (DGF)	Froswick (FWK)	Manitou (MXS)	Brund (BNI
		Calcareous Black				
		Rego Black	Hebbot (HEB)			
		Orthic Regosol	Worden (WOR)			Stall (SXG
	LBs	Orthic Dark Gray	Dezwood (DZW)	Oakley (OAY)	Fifere (FFR)	
		Dark Gray Luvisol	Pembina (PBI)		Nayler (NYO)	
		Orthic Gray Luvisol	Poyser (PYR)			
		Dark Gray Solonetz				Bento (BEO
		Orthic Regosol	Denton (DET)			
Imperfectly	Gt2	Gleyed Cumulic Regosol				
		Gleyed Black	Nikkel (NKK)		Nowell (NOW)	
		Gleyed Rego Black	Ferris (FRS)	Jirose (JIS)		Bisho (BIP
		Gleyed Solonetzic Black				Klida (KDA
	LBs	Gleyed Dark Gray	Zaplin (ZPI)		Fresno (FSO)	
		Gleyed Solonetzic Dark Gray				
Poorly	Gt2	Rego Humic Gleysol	Cazlake (CZK)			
	LBs	Rego Humic Gleysol	Horose (HOS)			
		Humic Luvic Gleysol	Pouchal (POU)			

the Soil Drainage Subgroup and Parent Materials.

of clay ered shale brk.	Fluvial or Lacustrine						Misc. Land Types
	F. Loamy /Till	S and GrS	Loamy /S and GrS	Sandy FS-LFS	Clayey (recent)	Loamy (recent)	
						Mowbray (MOW)	
s	Knudson (KUD)		Croyon (CYN)	Stockton (SCK)			
		Marringhurst (MRH)					
							Eroded Slopes Complex (ERX)
r							
	Altamont (ATN)	Leary (LRY)	Vandal (VDL)	Dobbin (DOB)			
	Kingsley (KIS)		Trinton (TNT)				
						Levine (LEI)	
	Ullrich (ULH)	Dexter (DXT)	Druxman (DXM)				
	Joyale (JYL)	Mansfield (MFI)	Capell (CXT)				
	Tellier (TLI)		Vartel (VTL)				
	Zinman (ZIM)						
	Guerra (GRR)	Fortina (FTN)	Carvey (CAV)		Kerran (KRN)	Basker (BKR)	Tredwell (TDW)
	Narish (NSH)		Yustak (YTK)				
	Watrine (WTI)						

Table 6b Relationship of the Soil Series in the Gt1 and Gt4 Subregions in Report D60 to the Soil Drainage Subgroup and Parent Materials.

Soil Drainage	Taxonomic Classification Subgroup	Parent Materials													
		Lacustrine and Fluvial Sediments													
		Sandy Skeletal (S and GrS)	Sandy (FS-LFS)	Sandy to Co. Loamy /Clayey	Loamy /Cal. Till	Co. Loamy (VFS,LVFS, FSL)	Loamy (VFSL,L,SiL) /Sandy	Loamy (VFSL,L,SiL /SiCL,CL)	Loamy /Clayey	Fine Loamy (SCL,CL,SiCL)	Fine Loamy Sandy	Loamy stratified	Loamy (shaly source)	Clayey (shaly source)	C s
Well to Moderately Well	Orthic Black	Agassiz (ASZ)	Stockton (SCK)	Hibsin (HIN)	Roseisle (RSI)	Hochfeld (HHF)	Rosengart (RSG)	Reinfeld (RFD)	Denham (DNH)	Eigenhof (ECF)	Edenburg (EBG)				W
	Calcareous Black	Birkenhead (BKA)													
	Cumulic Regosol		Aronet (ARN)									La Salle (LSL)			
	Orthic Regosol		Skelding (SKL)												
Imperfectly	Gleyed Black		Willowcrest (WWC)	Elm Creek (EEK)	Nanton (NTO)	Kronstal (KOT)	Jasset (JST)		Rignold (RGD)	Rathwell (RWL)					P
	Gleyed Rego Black		Almasippi (ASS)	Rosebank (RBK)	Glencross (GCS)	Reinland (RLD)	Neuenberg (NBG)	Gnadenthal (GDH)	Graysville (GYV)	Neuhorst (NUH)	Newton Siding (NWN)				D
	(strong calcareous)		St. Claude (SUE)	Squirrel Creek (SQR)											
	Gleyed Solonetzic Black													Gretna (GRA)	
	Gleyed Regosol		Long Plain (LOP)												
	Gleyed Cumulic Regosol								Pigeon Lake (PGK)			Gervais (GYS)	Chortitz (CTZ)	Blumengart (BMG)	F
												Poplar Point (PPR)			
Poorly	Rego Humic Gleysol		Lelant (LLT)	Layland (LAY)	Boxner (BOX)	Osterwick (OWK)		Blumenfeld (BNF)	Edkins (EDK)			Willowbend (WWB)	Loewen (LEW)	Blumenort (BUM)	
	Terric Mesisol		Perillo (PER)												
	Typic Mesisol		Xavier (XVI)												

Fine Loamy (SCL,CL,SiCL)	Fine Loamy Sandy	Loamy stratified	Loamy (shaly source)	Clayey (shaly source)	Clayey stratified	Clayey /sandy to Co. Loamy	Clayey (very fine)
Eigenhof (ECF)	Edenburg (EBG)				Winkler (WIK)	Jordan (JOD)	Myrtle (MYT)
		La Salle (LSL)					
Rathwell (RWL)					Plum Coulee (PME)	Horndean (HND)	Scanterbury (SCY)
Neuhorst (NUH)	Newton Siding (NWN)				Deadhorse (DHO)	Dugas (DGS)	Red River (RIV)
				Gretna (GRA)			Morris (MRS)
		Gervais (GYS)	Chortitz (CTZ)	Blumengart (BMG)	Fortier (FTE)		
		Poplar Point (PPR)					
		Willowbend (WWB)	Loewen (LEW)	Blumenort (BUM)			Osborne (OBO)

Agassiz Series (ASZ)

The Agassiz series consists of well to excessively drained Orthic Black soil developed on strongly calcareous, stratified, sandy skeletal (S,GrS,GrLS) beach deposits. These soils occur in upper and middle positions of gentle to moderate slopes on ridged landscapes; surface runoff is rapid. Permeability is rapid; water table is below 2 m during the growing season. Agassiz soils are slightly eroded, slightly stony, and non-saline. They have a low available water holding capacity, medium organic matter content, and low natural fertility. Native vegetation includes prairie grasses, shrubs and bur oak. The majority of these soils are currently excavated for road construction material.

The solum is approximately 40 cm thick with very dark gray Ah horizon, 7 to 15 cm thick, with single grain to weak granular structure; a brownish gray Bm horizon, 15 to 25 cm thick which is weakly developed. The Ck horizon is very pale brown with stratified sand and gravel. Agassiz soils were previously mapped as Blackearth associates of the Agassiz Association in the Carberry (1957) and the South-Central (1943) soil reports.

Almasippi Series (ASS)

The Almasippi series consists of imperfectly drained Gleyed Rego Black soil developed on moderately calcareous, uniform, sandy (LFS,FS) lacustrine sediments over a lacustrine clay substrate usually within 3 meters of the surface which impedes downward water movement. These soils occur in middle to lower slope positions of level to very gentle slopes on undulating landscapes; surface runoff is moderately slow. Permeability is rapid; water table is 1.5 m during the growing season. Almasippi soils are nonstony, usually nonsaline, and may have slight to moderate erosion. They have low available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes trembling aspen, bur oak and tall prairie grasses. The majority of these soils are currently used for grain crop production.

The solum is approximately 20 cm thick with a very dark gray Apk horizon, 15 to 20 cm thick; a light brownish gray AC horizon, 10 to 15 cm thick. The Ck horizon is yellowish brown with prominent mottles. A light coloured Ca horizon below the AC horizon may be present.

Almasippi soils occur in close association with Skelding, Longplain and Lelant soils. Almasippi soils were previously mapped as Black Meadow associates of the Almasippi Association in the Carberry (1957) and the intermediately drained Blackearth associate in the South-Central (1943) soil reports.

Altamont Series (ATN)

The Altamont series consists of well to moderately well drained Orthic Dark Gray soil developed on a mantle (25 to 100 cm) of weakly to moderately calcareous, uniform, fine loamy (L, CL, SiCL), lacustrine sediments over moderately to strongly calcareous, deep, uniform fine loamy (L, SiL, CL) mixed till deposits. These soils occur in middle to upper slope positions of very gentle slopes on undulating landscapes; surface runoff is moderate. Permeability is moderate; water table is below 2 m during the growing season. Altamont soils are noneroded, nonstony and nonsaline. They have high available water holding capacity, medium organ-

ic matter content, and high natural fertility. Native vegetation often includes tall prairie grasses interspersed with aspen-oak groves. The majority of these soils are currently used for grain crop production.

The solum is approximately 60 cm thick with a dark gray Ap or Ah horizon, 5 to 15 cm thick; a dark gray Ahe or AB horizon, 10 to 30 cm thick with rinsed ped surfaces; a brown to pale brown Bm horizon, 10 to 25 cm thick; a transition pale brown IIBC horizon 10 to 20 cm thick. Occasionally a white IICca horizon 4 to 6 cm thick is present. The parent material is typically pale brown to very pale brown strongly calcareous mixed till.

Altamont soils occur in close association with Kingsley, Knudson and Tellier soils. Altamont soils were previously mapped as the dominant associate of the Altamont Association in the reconnaissance soil survey of South-Central Manitoba (1943).

Aronet Series (ARN)

The Aronet series consists of moderately well drained Cumulic Regosol soil developed on weakly to moderately calcareous, sandy (FS,LS,LFS), eolian deposits. Aronet soils are found along fence rows, or adjacent to woodlots where wind blown sand can accumulate. These soils occur in upper slope positions of gentle to moderate slopes on ridged landscapes; and surface runoff is moderate. Permeability is rapid; water table is below 2 m during the growing season. Aronet soils are nonstony, and nonsaline. They have moderate available water holding capacity, variable organic matter content, and moderate natural fertility. Native vegetation includes tall prairie grasses. The majority of these soils are currently in native vegetation.

The profile is characterized by a light brown Ap horizon, 5 to 20 cm thick, with single grain structure, and a number of alternating dark brown and light brown layers. The darker layers are mostly buried Ah horizons. The overblown layers usually overlie a Chernozem like profile at depth. The parent material is typically mottled at depths of 75 cm or more.

Aronet soils occur in close association with Skelding, Longplain and Willowcrest soils. Aronet soils were previously mapped as eroded inclusions of the Almasippi Association in the Carberry (1957) soil report.

Basker Series (BKR)

The Basker series consists of poorly to very poorly drained Rego Humic Gleysol soil developed on moderately to strongly calcareous, stratified, loamy (FSL,VFSL,L,SiL,SiCL), recent alluvial deposits. These soils occur in depression positions of nearly level slopes on flood plain landscapes; surface runoff is very slow to ponded. Permeability is slow; and a water table is at or near the surface during the growing season. Basker soils are nonstony, and occasionally slightly saline. They have a high available water holding capacity, and medium organic matter content. Native vegetation includes sedges, rushes and willows. The majority of these soils are currently in native vegetation because they are subject to flooding and saturated conditions in the spring.

A representative profile of Basker soil is characterized by light grayish brown Ahk horizon, 5 to 20 cm thick, with iron stains, and a stratified, olive brown Ckg horizon, with prominent iron mottles in the sandy strat. The profile also contains

thin organic layers indicating former surfaces.

Basker soils occur in close association with Levine soils. Basker soils were previously mapped as Meadow associates of the Assiniboine Complex in the South-Central (1943) and Carberry (1957) reports.

Benton Series (BEO)

The Benton series is characterized by pedons which occur in the LBs_2 ecoregion, have a Dark Gray Solonetz solum, moderately well to well soil drainage, and materials on either a thin veneer of clay, or weathered shale, overlying non-to-weakly calcareous shale bedrock (commonly on Millwood member). These soils have a hard columnar structure due to the presence of sufficient sodium in solution and the exchange complex; sodium salts are also associated with some shale beds of the Pembina member. White gypsum-like crystals (selenite) and jarosite (yellow) are common in the subsoil and weathered bedrock. They occur in gently sloping to hummocky dissected landscapes or along the upper slopes of the escarpment area; slopes of 3 to 9 percent are common. Runoff is moderate to rapid; permeability is very slow.

The solum has a thin LH horizon 2 to 4 cm thick, a dark gray Ahe horizon 3 to 10 cm thick, a very thin Ae immediately above the columnar Bn or Bnt horizon. The Bn(t) horizon may be subdivided into a Bn_1 and Bn_2 based on structure. The Bn_1 is 15 to 30 cm thick, strong columnar and very hard when dry, very plastic when moist. The Bn_2 has a massive to weak angular blocky structure and very plastic when moist; thickness of the Bn_2 varies from 10 to 25 cm; a BC or C horizon of variable thickness is usually present above the shale bedrock. The solum depth may vary from 55 to 75 cm; depth to the shale varies within the various topographic positions, but usually within 90 cm. Gypsum (selenite) and jarosite are commonly found in the shale bedrock. These beds have considerable pyrite present; they undergoe considerable expansion when exposed to oxidative and moist conditions.

Most of these soils have been utilized as natural grazing areas. Under cultivation the Ahe, Ae and Bn_1 horizons become incorporated into the plowlayer; the plow layer may have a massive to angular blocky structure that becomes quite difficult to work when moist and very hard when dry.

Birkenhead Series (BKA)

The Birkenhead series is a Calcareous Black soil developed on moderately well drained, moderately to strongly calcareous, stratified sandy (LS, S, CS) and gravelly deposits. There is usually a surface mantle ranging in texture from loamy fine sand to sand over the coarser textured materials. These soils occur on gently sloping, stone-free, northwest-southeast trending beach ridges formed by glacial Lake Agassiz below the Manitoba Escarpment. Surface runoff is moderate to slow, and permeability is rapid. The native prairie grasses once associated with these soils, have been mostly replaced by cultivated grasses and legumes such as brome grass and alfalfa.

The Birkenhead soil profile has a very dark gray Ah horizon, 15 to 30 cm thick; a weakly calcareous, stratified, brown Bm horizon, 10 to 20 cm thick, and a pale brown, moderately to strongly calcareous C horizon.

These soils are affected by droughtiness as a result of their rapid permeability and low water-holding capacity.

Bishop Series (BIP)

The Bishop series consists of imperfectly drained Gleyed Rego Black soil developed on a shallow mantle (60 to 100 cm) of moderately calcareous, uniform, clayey (SiC,C) deposits containing shale fragments over non- to weakly calcareous weathered shale bedrock. These soils occur in middle to lower positions of moderate slopes on the Manitoba Escarpment; surface runoff is moderate. Permeability is slow to very slow. Water table is within 1 m during the growing season; the subsoil is influenced by seepage from the upper slopes. Bishop soils are nonstony, and frequently weakly saline. They also have a high available water holding capacity, moderate organic matter content. Native vegetation includes shrubs, willows, ash and oak. The majority of these soils are currently in native vegetation.

The solum is approximately 30 cm thick and is characterized by a dark gray to very dark gray Ah horizon, 25 to 35 cm thick, usually with carbonates and salts, and a transitional AC horizon, 30 to 40 cm thick with carbonates, mottles and gypsum crystals. Shale bedrock usually occurs at a depth of 75 to 90 cm.

Blumenfeld Series (BNF)

The Blumenfeld series consists of poorly drained Rego Humic Gleysol soil developed on moderately to strongly calcareous, loamy (VFSL,L,SiL,SiCL, CL), fluvial and lacustrine deposits. These soils occur in surface runoff level to depressional positions of level slopes on level landscapes; is very slow to ponded. Permeability is moderately slow. Water table within 1 m during the growing season. They are noneroded, nonstony, and frequently slightly saline. They have a medium available water holding capacity, medium organic matter content, and low natural fertility. Native vegetation includes sedges, seeds, rushes and meadow grasses. The majority of these soils are currently in native vegetation.

The solum is approximately 40 cm thick; and is characterized by a carbonated, very dark gray Ah horizon, 25 to 40 cm thick, a thin, dark grayish brown AC horizon, 10 to 15 cm thick with prominent mottles. The parent material is light gray with prominent iron mottles and usually contains a Cca horizon of lime accumulation.

Blumenfeld soils occur in close association with Gnadenthal and Reinfeld soils. Blumenfeld soils were previously mapped as meadow associates of the Rathwell Association in the Carberry (1957) and poorly drained associate of the Altona, fine loam in South-Central (1943) soil report.

Blumengart Series (BMG)

The Blumengart series consists of imperfectly drained Gleyed Regosol soil developed on weakly to moderately calcareous, clayey (SiC,C), recent fluvial deposits. The soils have been prone to flooding, but improved drainage has decreased the flooding hazard in recent years. These soils occur in level to depressional positions of level slopes on flood plain landscapes; surface runoff is slow. Permeability is very slow; water table is between 1 to 2 m during the growing season. They are non-eroded, non-stony, and frequently slightly saline. They have a high available water holding capacity, moderate organic matter content, and medium natural fertility. Native vegetation includes tall prairie grasses, willows and shrubs. The majority of these soils are currently cultivated.

The profile is characterized by a dark gray Ah horizon, 10 to 18 cm thick, and a gray to dark gray Ck horizon, with prominent iron mottles; thin strata of lighter textured former Ah horizons may be present in the subsoil.

Blumengart soils occur in close association with Blumenort soils. Blumengart soils were previously mapped as immature associates of the Gretna Association in the South-Central (1943) soil report.

Blumenort Series (BUM)

The Blumenort series consists of poorly drained Rego Humic Gleysol soil developed on moderately calcareous, deep, stratified, clayey (SiC,C), recent alluvial deposits in flood prone areas along stream channels at the base of the Manitoba Escarpment. These soils occur in depressional positions of nearly level slopes on level landscapes; runoff is slow to ponded. Permeability is very slow; water table is within 1 m during the growing season. Blumenort soils are non-eroded, non-stony, and frequently moderately saline. They have a high available water holding capacity, high organic matter content, and low natural fertility. Native vegetation includes sedges, rushes, reeds and willows. The majority of these soils are currently drained to reduce the hazard of flooding; they are used for cereal crop production.

The solum is approximately 20 cm thick with a very dark gray, calcareous Ah horizon, 10 to 18 cm thick, with slight salinity; a thin transitional AC horizon, 5 to 10 cm thick. The Ck horizon is dark olive gray with numerous fine distinct mottles, and light gray gypsum crystals.

Blumenort soils occur in close association with Blumengart soils. Blumenort soils were previously mapped as Meadow associates of the Gretna Association in the South-Central (1943) soil report.

Boxner Series (BOX)

The Boxner series is characterized by pedons which occur in the Gt$_4$ ecoregion in proximity to the Manitoba Escarpment, have a Rego Humic Gleysol (carbonated) solum, poor soil drainage, and parent material sequence of shallow (less than 90 cm) loamy (L, SiL, VFSL, CL, SiCL), moderately to strongly calcareous, fluvial and lacustrine sediments over strongly calcareous stony water modified glacial till. The change from the loamy textured overlay to the water modified till is abrupt; a gravelly or cobbly strata usually occurs at the contact. These soils occur in the western part of the Red River Plain and lower slopes of the Escarpment; they are influenced by seepage and considerable ponding. A thin peaty layer may be present within the mapped areas.

The solum has a variable mucky or peaty layer of 5 to 15 cm thick and a black, carbonated Ah horizon 10 to 15 cm thick. The underlying parent material (Ckg) is dark olive gray.

Brundis Series (BNI)

The Brundis series is characterized by an Orthic Black solum; soil drainage is moderately well to well, and a veneer of non to weakly calcareous clayey deposits or weathered (altered) shale overlies non to weakly calcareous shale bedrock. These soils occur in the upper slopes of the Escarpment area or in local areas

above the Escarpment that have had considerable erosion and dissection; slopes may vary from 3 to 15 percent. Runoff is slope-related and varies from moderate to rapid. Permeability is slow to very slow when soils are moist to wet, but may vary with the structure of the soil. These soils have a high shrink-swell property. Brundis soils were previously included with the Benton Association in the South-Central (1943) soil report.

Capell Series (CXT)

The Capell series consists of imperfectly drained Gleyed Rego Black soil developed on a mantle (25 to 100 cm) of moderately to strongly calcareous, stratified, loamy (SiL, L, CL), lacustrine sediments over moderately to strongly calcareous, deep stratified, sandy to sandy-skeletal (GrS, GrLS), glaciofluvial deposits. These soils occur in lower slope positions of gentle to moderate slopes on hummocky landscapes; surface runoff is moderate. Permeability is moderate to rapid; water table is between 1 to 2 m during the growing season. Capell soils are occasionally slightly saline. They have medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes tall prairie and meadow grasses; the majority of these soils are currently used for grain crop production.

The solum is approximately 25 cm thick, with a very dark gray to black Apk or Ahk horizon, 15 to 25 cm thick; a dark gray to gray, calcareous AC horizon, 5 to 15 cm thick. The second parent material (IICk horizon) is a light yellowish brown with common, distinct iron mottles. A light gray IICca horizon, 5 to 10 cm thick with secondary carbonate accumulation is commonly present at or below the contact.

Capell soils occur in close association with Croyon and Carvey soils. The soils were previously mapped as an imperfectly drained associate of the Agassiz Association in the reconnaissance soil survey of South-Central Manitoba (1943).

Carvey Series (CAV)

The Carvey series consists of poorly drained Rego Humic Gleysol soil developed on a mantle (25 to 100 cm) of moderately to strongly calcareous, uniform, loamy (SiL, L, SL) lacustrine sediments over moderately to strongly calcareous, sandy to sandy skeletal glaciofluvial deposits. These soils occur in depressional positions with nearly level slopes on level landscapes; surface runoff is slow to ponded. Permeability is moderate; water table is within 1 m during the growing season. Carvey soils are usually nonsaline. Available water holding capacity is medium in the loamy overlay and low in the sandy skeletal material. They have a high organic matter content, and medium natural fertility. Native vegetation is sedges and meadow grasses. Land use is currently natural grazing.

The solum is approximately 20 cm thick, with a thin (2 to 5 cm) moderately decomposed Om horizon; a very dark gray, calcareous Ah horizon, 7 to 15 cm thick; and a dark gray, calcareous, transition AC horizon, 10 to 20 cm thick. The IICk horizon is pale brown, calcareous with yellowish brown mottles and manganese concretions. Shell fragment are common at the surface.

Carvey soils occur in close association with Capell, Druxman and Croyon soils. Carvey soils were previously mapped as a Meadow associate with loamy veneer of the Agassiz As-

sociation in the Carberry (1957) and South-Central soil report.

Cazlake Series (CZK)

The Cazlake series consists of poorly drained Rego Humic Gleysol soil developed on moderately to strongly calcareous (CL, L, SiCL), deep uniform till of mixed limestone granite and shale origin. These soils occur in level to depressional positions on gently to moderately sloping hummocky landscapes; surface runoff is very slow to ponded. They have slow permeability. Water table is at the surface in the spring and within 1 m during the growing season. Cazlake soils are noneroded, slightly stony and may be slightly saline. They have a high available water holding capacity, high organic matter content, and low natural fertility. Native vegetation is sedges, cattails and reeds. The majority of these soils are currently in their natural state due to restricted drainage and high water tables.

The solum is approximately 25 cm thick, with a black Ah or Ap horizon, 15 to 50 cm thick; a light olive gray carbonated AC horizon, 5 to 10 cm thick. The C horizon is light gray with many prominent iron mottles. The surface also contains up to 40 cm of inwash due to soil erosion from upslope areas.

Cazlake soils occur in close association with Darlingford, Nikkel and Ferris soils. They are similar to Horose soils by having the same soil development and parent material, differing only in that Horose soils are associated with Dark Gray Chernozems. Cazlake soils were previously mapped as poorly drained associates of the Darlingford association in the reconnaissance soil survey of South-Central Manitoba (1943).

Chortitz Series (CTZ)

The Chortitz series consists of imperfectly drained, Gleyed Cumulic Regosol soil developed on moderately calcareous, deep, stratified, loamy (SiL,L,CL,SiCL), recent alluvial deposits. Lighter strata of fine sand to sandy loam, or, heavier strata of silty clay to clay can be present. These soils occur in middle positions of very gentle slopes on flood plain landscapes and have slow surface runoff. They have moderately slow permeability and a high water table during the growing season.

Croyon Series (CYN)

The Croyon series consists of moderately well to well drained Orthic Black soil developed on a mantle (25 to 100 cm) of moderately to strongly calcareous, uniform, loamy (L, SiL, CL) lacustrine sediments over moderately to strongly calcareous, stratified, deep sandy-skeletal (GrS, GrLS), glacio-fluvial deposits. These soils occur in middle and upper slope positions of very gentle slopes on undulating landscapes; surface runoff is moderately rapid. They have medium permeability in the upper loamy strata and rapid permeability in the coarser substrata. The water table is usually below 2 m during the growing season. Croyon soils have medium available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation includes tall prairie grasses interspersed with aspen-oak groves. The majority of these soils are currently used for grain crop production.

The solum is approximately 35 cm thick with a very dark gray Ah or Ap horizon, 10 to 15 cm thick; a dark brown Bm horizon, 10 to 25 cm thick. It is underlain by a yellowish brown IICca horizon, 10 to 20 cm thick with

secondary carbonate accumulation and a light yellowish brown IICk horizon. The parent material is typically stratified with thin (<5 cm) layers of SiL, CS, GrS and SL textures.

Croyon soils occur in close association with Zarnet, Capell and Druxman soils. Croyon soils were previously mapped as loamy surface associates of the Agassiz association in the reconnaissance soil survey of South-Central Manitoba (1943).

Darlingford Series (DGF)

The Darlingford series consists of well drained Orthic Black soil developed on moderately to strongly calcareous, deep, uniform, loamy (L,CL,SiCL), nearly stone-free mixed till deposits. These soils occur in middle to upper positions of very gentle to gentle slopes on undulating to rolling landscapes and have medium to moderately slow permeability moderate surface runoff and a medium water table during the growing season. Darlingford soils are slightly eroded and slightly stony. They have moderate available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation often includes tall prairie grasses interspersed with aspen poplar stands. The majority of these soils are currently used for grain crop production.

The solum is approximately 60 cm thick with a very dark gray Ap or Ah horizon, 15 to 20 cm thick; a black Ah horizon, 5 to 10 cm thick; a brown to dark brown Bm or Btj horizon, 20 to 30 cm thick. A pale brown Cca horizon 10 to 15 cm thick is usually present. The parent material is typically yellowish brown mixed till with few coarse fragments.

Darlingford soils occur in close association with Dezwood, Nikkel and Cazlake soils. Darlingford soils were previously mapped as the dominant associate of the Darlingford association in the reconnaissance soil survey of South-Central Manitoba (1943).

Deadhorse Series (DHO)

The Deadhorse series consists of imperfectly drained Gleyed Rego Black soil developed on moderately to strongly calcareous, deep, stratified, clayey (SiC,C), fluvial and lacustrine deposits. Thin strata of very fine sand to clay loam often occur within 1-2 meters of the surface. These soils occur in middle positions of level to very gentle slopes on undulating landscapes and have very slow permeability, slow surface runoff, and a high water table during the growing season. Deadhorse soils are non-eroded, non-stony, and may be slightly saline. They have a high available water holding capacity, high organic matter content, and high natural fertility. Native vegetation includes tall prairie grasses, aspen and oak. The majority of these soils are currently cultivated for grain crop production.

The solum is approximately 20 cm thick with a very dark gray Ah horizon, 12 to 25 cm thick; a carbonated, dark gray to gray AC horizon, 8 to 20 cm thick. The Ck horizon has faint mottles.

Deadhorse soils occur in close association with Winkler and Plum Coulee soils. Deadhorse soils were previously mapped as clayey Black Meadow associates of the Rathwell Association in the Carberry (1957) soil report and the imperfectly drained associate of the Morden Association in the South-Central (1943) soil report.

Denham Series (DNH)

The Denham series consists of moderately well to well drained Orthic Black soil developed on a mantle (60 to 90 cm) of moderately to strongly calcareous, shallow, loamy (VFSL,L,SiL), lacustrine sediments over moderately to strongly calcareous, deep, clayey (SiC,C,SC), lacustrine deposits. These soils occur in upper positions of very gentle slopes on undulating landscapes; surface runoff is moderate to moderately rapid. Water table is low during the growing season. Permeability is moderate in the loamy strata and slow in the clayey subsoil. Denham soils are non-eroded, non-stony, and non-saline. They have medium available water holding capacity, high organic matter content, and high natural fertility. Native vegetation includes aspen, oak, shrubs and prairie grasses. The majority of these soils are currently cultivated for grain crop production.

The solum is approximately 50 cm thick with a very dark gray to black Ap horizon, 20 to 30 cm thick; a very dark grayish brown to brown Bm horizon, 25 to 35 cm thick; a weakly calcareous BC horizon, 5 to 10 cm thick. The C horizon is yellowish brown to pale brown and moderately to strongly calcareous and faintly mottled at depth.

Denham soils occur in close association with Rignold, Graysville and Edkins soils. Denham soils were previously mapped as Blackearth associates of the Rathwell Association in the Carberry (1957) soil report or well drained member, the Altona, heavy subsoil phases in the South-Central (1943) soil report.

Dexter Series (DXT)

The Dexter series consists of imperfectly drained Gleyed Black soil developed on moderately to strongly calcareous, deep, stratified, sandy skeletal (FS,CS,GrS), glaciofluvial deposits. These soils occur in middle positions of very gentle to gentle slopes on undulating landscape; surface runoff is moderate. The soil has rapid permeability and a medium water table during the growing season. Dexter soils may be slightly eroded, non-stony, and non-saline. They have a low available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes bur oak, aspen, shrubs and prairie grasses. The majority of these soils are currently used for forage crops and grazing.

The solum is approximately 40 cm thick with a very dark gray Ah horizon, 15 to 20 cm thick; a grayish brown to brown Bm horizon, 10 to 25 cm thick. A Cca horizon, 5 to 8 cm thick with lime accumulation is commonly present and is mottled. The Ck horizon is calcareous. The solum thickness varies depending on the depth of finer textured surface layers.

Dexter soils occur in close association with Dorset, Marringhurst and Fortina soils. In the Escarpment area, the Dexter series has been mapped in association with the Birkenhead series.

Dezwood Series (DZW)

The Dezwood series consists of moderately well to well drained Orthic Dark Gray soil developed on moderately to strongly calcareous, deep, uniform, loamy (L, CL, SiCL) mixed shale, limestone and granite till deposits. These soils occur in middle

and upper positions of gentle to moderate slopes on hummocky landscapes; surface runoff is moderate to rapid. They have medium to moderately slow permeability and a medium water table during the growing season. Dezwood soils are slightly eroded and slightly stony. They have medium available water holding capacity, medium organic matter content, and medium to high natural fertility. Native vegetation often includes tall prairie grasses interspersed with aspen-poplar groves. The majority of these soils are currently used for grain crop production.

The solum is approximately 40 cm thick with a dark grayish brown Ah or Ap horizon, 15 to 20 cm thick; occasionally a thin light gray Ae horizon, 2 to 4 cm thick; a pale brown Bt horizon, 20 to 40 cm thick. A light gray Cca horizon 15 to 30 cm thick is usually present. The parent material is typically light gray mixed till with few coarse fragments.

Dezwood soils occur in close association with Ferris, Zaplin and Nikkel soils. Dezwood soils were previously mapped as gray black associates of the Pembina Association in the reconnaissance soil survey of South-Central Manitoba (1943).

Dobbin Series (DOB)

The Dobbin series consists of well drained Orthic Dark Gray soil developed on weakly to non-calcareous, deep, sandy (LFS,FS,S), lacustrine and eolian deposits. These soils occur in middle and upper positions of gentle slopes on undulating to hummocky landscapes; surface runoff is rapid. Permeability is rapid. The water table is low during the growing season. They have a low available water holding capacity, low organic matter content, and low natural fertility. Native vegetation includes aspen groves, bur oak, shrubs and tall prairie grasses. The majority of these soils are currently utilized for forage and crop production.

The solum is approximately 90 cm thick with a gray to dark gray Ap horizon, 20 to 35 cm thick; a grayish brown to brown Bm horizon, 40 to 55 cm thick; a dark grayish brown Btj or Bt horizon, 5 to 10 cm thick with clay accumuation; and a transitional BC horizon, 15 to 20 cm thick. A typical profile also contains thin strata of VFSL to SiL textures.

Dobbin soils occur in close association with Stockton, Lavenham and Sewell soils. Dobbin soils were previously mapped as degraded Black associates of the Stockton Association in the Carberry (1957) soil report.

Druxman Series (DXM)

The Druxman series consists of imperfectly drained Gleyed Black soil developed on a mantle (25 to 100 cm) of moderately to strongly calcareous, loamy (VFSL, L, SiL, CL, SiCL) sediments overlying stratified, deep, sandy-skeletal (GrS, GrLS), glaciofluvial deposits. These soils occur in lower slope positions of very gentle slopes on undulating landscapes; runoff is moderately slow. Permeability is moderate in the loamy sediments and rapid permeability in the coarser sandy materials. They have a high water table during the spring and early summer. Druxman soils have medium available water holding capacity, medium organic matter content and medium natural fertility. Native vegetation often includes meadow and tall prairie grasses interspersed with willow clumps. The majority of these soils are currently used for grain crop production.

The solum is approximately 50 cm thick with a very dark gray Ah or Ap horizon, 15 to 25 cm thick; a dark yellowish brown to olive brown Bm horizon, 20 to 30 cm thick with many, fine, distinct, yellowish brown iron mottles; a transitional dark yellowish brown BC, 5 to 10 cm thick. The parent material (IICk) is light yellowish brown with many, large prominent iron mottles. A yellowish brown IICca horizon, 5 to 10 cm thick may be present.

Druxman soils occur in close association with Croyon and Carvey soils. Druxman soils were previously mapped as imperfectly drained associates of the Agassiz Association in the reconnaissance soil survey of South-Central Manitoba (1943).

Dugas Series (DGS)

The Dugas series consists of imperfectly drained Gleyed Rego Black soil developed on a mantle (40 to 70 cm) of moderately to strongly calcareous, shallow, uniform, clayey (SiC,C), lacustrine deposits over moderately to strongly calcareous, deep, stratified, sandy (FS,LFS,S), and loamy (L,SiL,CL), lacustrine, deposits. These soils occur in midslope positions of very gentle sloping to level landscapes; surface runoff is moderate. Permeability is slow in the clayey sediments and moderate to rapid in the stratified loamy to sandy subsoils. They have a high water table during the growing season. Dugas soils are non-eroded, non-stony, and occasionally slightly saline. They have a high available water holding capacity, high organic matter content, and medium natural fertility. Native vegetation includes tall prairie and meadow grasses. The majority of these soils are currently cultivated for grain production.

The solum is approximately 25 cm thick with a black Ap or Ah horizon, 12 to 15 cm thick; and a calcareous, very dark grayish brown AC horizon, 10 to 20 cm thick. The parent material (Ckg) is a dark grayish brown 15 to 25 cm thick, and is underlain by a light olive brown IICkg horizon, with many distinct reddish brown mottles.

Dugas soils were previously mapped as Black Meadow associates of the Rathwell Association in the Carberry (1957) soil report, and the Morden or Horndean Association of the South-Central (1943) report.

Edenburg Series (EBG)

The Edenburg series is an Orthic Black soil developed on moderately well drained, moderately to strongly calcareous, shallow (less than 90 cm, fine loamy (CL, SiCL) sediments abruptly grading to sandy (LFS, FS) lacustrine sediments. These soils occur below the Escarpment and on western portions of the Red River Plain on level to very gently sloping topography; surface runoff is slow. Permeability is moderate in the loamy sediments, and rapid in the sandy subsoil. These soils can have a high water table at approximately one meter depth for short periods in the spring.

The solum has a very dark gray to black Ap and Ah horizon, 25 to 35 cm thick; a very dark grayish brown Bm horizon, 25 to 35 cm thick; and a thin, 5 to 10 cm thick transition BC horizon. A Cca horizon often occurs above the contact with the sandy sediments.

The Edenburg soils occur in association with the Newton Siding soils. They were previously mapped as inclusions of the Rathwell Association in

the Carberry (1957) soil report and as the moderately well drained Altona heavy Association of the South-Central (1943) soil report.

Edkins Series (EDK)

The Edkins series consists of poorly drained Rego Humic Gleysol soil developed on a mantle (40 to 60 cm) of moderately to strongly calcareous, shallow loamy (L,SiL,SiCL,CL), lacustrine deposits over moderately to strongly calcareous, clayey (C,SiC lacustrine deposits. These soils occur in level to depressional positions of nearly level slopes on level landscapes and have restricted permeability, slow surface runoff, and a high water table during the growing season. Edkins soils are non-eroded, non-stony, and frequently slightly saline. They have a high available water holding capacity, high organic matter content, and low natural fertility. Native vegetation includes sedges, rushes, willows and reeds. The majority of these soils are currently under native vegetation.

The solum is approximately 25 cm thick with very dark gray, calcareous Ah horizon, 15 to 30 cm thick; a light gray AC horizon, 8 to 20 cm thick. Usually a Cca horizon, 5 to 10 cm thick with lime accumulation is present. The C horizon is calcareous with mottles and gypsum crystals.

Edkins soils occur in close association with Denham, Graysville and Rignold soils. Edkins soils were previously mapped as Meadow associates of the Rathwell Association in the Carberry (1957) soil report; and poorly drained associate in the Altona, heavy substrate Association, the South-Central (1943) soil report.

Eigenhof Series (EGF)

The Eigenhof series consists of moderately well to well drained Orthic Black soil developed on moderately to strongly calcareous, deep, stratified, fine loamy (SCL,SiCL,CL), lacustrine deposits. These soils occur in upper positions of nearly level to very gentle slopes on undulating landscapes; surface runoff is moderate. Permeability is moderate to moderately slow; water table is low during the growing season. They have a high available water holding capacity, high organic matter content, and high natural fertility. Native vegetation includes tall prairie grasses. The majority of these soils are currently cultivated for grain crop production.

The solum is approximately 40 cm thick with a very dark gray to black Ah horizon, 15 to 25 cm thick; a grayish brown Bm horizon, 15 to 20 cm thick; and a weakly calcareous, transitional BC horizon 5 to 15 cm thick. The parent material is moderately calcareous, and stratified with SiL and SiCL textures; thin layers of fine sand to silt are common.

Eigenhof soils occur in close association with Neuhorst soils. They are similar to Denham soils by having an Orthic Black profile but differ from them in not having a clayey substrate diagnostic of Denham soils. Eigenhof soils were previously mapped as well drained, Blackearth associates of the Rathwell Association in the Carberry (1957) soil report and inclusions within the Morden Association of the South-Central(1943) soil report.

Elm Creek Series (EEK)

The Elm Creek series consists of imperfectly drained Gleyed Black soil developed on a mantle (50 to 80 cm) of weakly to moderately calcareous, shallow sandy to coarse loamy (FS,LFS,VFS,LVFS,FSL), lacustrine deposits over moderately calcareous, deep uniform, clayey (SiC,C), lacustrine deposits. These soils occur in middle positions of very gentle slopes on level to undulating landscapes; surface runoff is slow. Permeability of the sandy to coarse loamy sediments is moderately rapid to rapid, and slow in the clayey substrata. They have a perched water table above the clay during the spring and following heavy summer rains. Elm Creek soils are non-eroded, non-stony, and occasionally slightly saline. They have a medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes prairie grasses, aspen-oak groves, and meadow grasses. The majority of these soils are currently cultivated for grain crop production.

The solum is approximately 45 cm thick with a very dark gray to dark gray Ah horizon, 18 to 25 cm thick; a grayish brown to dark grayish brown Bmgj horizon, 25 to 40 cm thick with many distinct mottles. An accumulation of lime carbonate (Cca horizon) 10 to 15 cm thick may be present when the depth to the clay is more than 90 cm. The underlying clay (IICkg) is brownish gray to gray with distinct yellowish brown mottles.

Elm Creek soils occur in close association with Hibsin, Rosebank and Layland soils. They are similar to Rosebank soils by having an imperfectly drained profile in coarse loamy over clayey deposits but differ from them in having a Bm horizon. Elm Creek soils were previously mapped as associates of the Almasippi clay substrate Association in the Carberry (1957) soil report.

Eroded Slope Complex (ERX)

This soil complex includes all the land occupied by the eroded slopes of river valleys and walls and incised stream channels and ravines that have down-cut through the surface deposits and shale bedrock. These are generally well drained, strongly to steeply sloping landforms that have variable soil development on materials that are variable in composition, depending on the nature of the surrounding deposits. Due to their complexity, these areas are classified as a miscellaneous land type rather than a unit characterized by a soil series. These areas are typically influenced by mass wasting processes such as slump, creep, solifluction and erosion.

In the study area the soils range from Orthic Blacks to Regosols. The materials are largely deep lacustrine, fluvial and eolian which are subsequently deposited as colluvium along the slopes. Shale bedrock is often exposed in the mid to lower slope positions. The slopes are characterized by numerous major seepage zones where the water table intersects the slope walls or scarps, generally in the mid to lower slopes. Seepage areas often take the form of semicircular "punch bowl" type emergence patterns. The maintenance of vegetation on the Eroded Slopes is essential for their stability.

Ferris Series (FRS)

The Ferris series consists of imperfectly drained Cleyed Rego Black soil developed on moderately to strongly calcareous, deep, uniform, fine loamy and fine silty (SiL,L,CL,SiCL) slightly stony mixed till deposits. These soils occur in lower positions of very gentle slopes on undulating landscape; surface runoff is slow. Permeability is moderate to moderately slow. Water table is between 1 to 2 m during the growing season. Ferris soils are noneroded, slightly stony and usually nonsaline. They have high available water holding capacity, high organic matter content, and high natural fertility.

The solum is approximately 30 cm thick with a black, carbonated Ap horizon, 25 to 35 cm thick; and a dark gray, transitional AC horizon, 15 to 30 cm thick with iron mottles. The parent material is typically light yellowish brown mixed till with iron mottles. A light gray to pale yellow Cca horizon 10 to 15 cm thick with lime accumulation is commonly present.

Ferris soils occur in close association with Zaplin and Nikkel soils. Ferris soils were previously mapped as imperfectly drained Blackearth associates of the Pembina association in the reconnaissance soil survey of South-Central Manitoba (1943).

Fifere Series (FFR)

The Fifere series consists of well drained Orthic Dark Gray soil developed on weakly calcareous to neutral, shallow uniform, fine loamy and fine silty (SiL, L, CL) till derived from shale bedrock. These soils occur in upper positions of gentle to moderate slopes on hummocky and ridged landscapes; surface runoff is moderate to rapid. Permeability is moderate. Water table during the growing season is low. Fifere soils are moderately eroded. They have moderate available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes oak, aspen-poplar and shrubs. The majority of these soils are currently used for grain crop production.

The solum is approximately 70 cm thick with gray brown Ap or Ah horizon, 15 to 18 cm thick; a light brownish gray Bt horizon, 25 to 35 cm thick; a light grayish brown transitional BC horizon, 10 to 30 cm thick. The parent material is light grayish brown non-calcareous shale till. Numerous shale fragments of various size occur throughout the soil.

Fifere soils occur in close association with Manitou, Nayler and Fresno soils. Fifere soils were previously mapped as wooded associates of the Manitou association in the reconnaissance soil survey of South-Central Manitoba (1943).

Fortier Series (FTR)

The Fortier series is a Gleyed Cumulic Regosol soil developed on imperfectly drained, moderately to strongly calcareous, clayey (SiC, C) fluvial sediments. These soils occur in smooth, level topography beyond the levees in association with Willowbend, Gervais and La Salle soils. Periodic overflow or ponding occurs with spring runoff or during periods of high rainfall. Surface runoff is slow. Permeability is slow due to the clay textures and downward movement can be restricted by a high water table, especially in spring. Although most Fortier soils are cultivated, small remnant stands of

native vegetation support tall prairie and prairie-meadow grasses with some deciduous trees.

The Fortier soil profile has a weak, dark gray to gray Ah horizon, 10 to 20 cm thick which is slightly darker in color than the underlying mottled C horizon. Thin layers of very fine sandy loam, silt loam and silty clay loam are often present in the dominantly clayey profile. Buried Ah horizons occur in profiles in some areas. Fortier soils are finer textured and less permeable than the coarser textured Gervais soils.

These soils have moderately severe agricultural limitations due to wetness and the possibility of seasonal inundation. Fortier soils take longer to warm up in spring and take longer to become trafficable after rain than coarser textured soils.

Fortier soils occur in association with Gervais soils. Fortier soils were previously mapped as immature, imperfectly drained (resembling Black-Meadow soils in characteristics) members of the Oakville Association in the Carberry (1957), and Winnipeg-Morris (1953) report and as immature imperfectly drained members of the Riverdale Association in the South-Central (1943) report.

Fortina Series (FTN)

The Fortina series consists of poorly drained Rego Humic Gleysol soil developed on moderately to very strongly calcareous, deep, stratified, sandy skeletal (S,GrS,GrLS), glacial fluvial deposits. These soils occur in depressional positions of nearly level slopes on level landscapes; runoff is very slow. They have moderately rapid to rapid permeability, and a high water table during the growing season. Fortina soils are non-eroded, non-stony, and non-saline. They have a low available water holding capacity, moderate organic matter content, and low natural fertility. Native vegetation includes sedges, rushes, reeds and willows. The majority of these soils are currently in native vegetation.

The solum is approximately 30 cm thick with a black Ah horizon, 20 to 30 cm thick, with carbonates; a surface mesic to humic organic layer of 5 to 10 cm is usually present. The parent material (Ckg) is typically stratified with sand and gravel and contains numerous prominent mottles. Usually a Cca horizon, 15 to 25 cm thick with many distinct mottles occurs below the solum.

Fortina soils occur in close association with Dexter and Dorset soils. Fortina soils were previously mapped as Meadow associates of the Marringhurst Association in the Carberry (1957) soil report.

Fresno Series (FSO)

The Fresno series consists of imperfectly drained Gleyed Dark Gray soil developed on weakly calcareous to neutral, shallow uniform, fine loamy and fine silty (SiL, L, CL), till derived from shale bedrock. These soils occur in lower slope positions of gentle to moderate slopes on hummocky and ridged landscapes; surface runoff is moderately slow. They have moderate permeability and a high water table during the growing season. They have medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes tall prairie and meadow grasses. The majority of these soils are currently used for production of grain crops.

The solum is approximately 70 cm thick with a grayish brown Ap or Ah horizon, 15 to 20 cm thick; an Ahe or transitional AB horizon, 15 to 25 cm thick with rinsed ped surfaces; a light grayish brown Bm or Bt horizon, 25 to 35 cm thick with a few, fine, faint iron mottles; and a light grayish brown transitional BC horizon 10 to 20 cm thick with a few, fine, faint iron mottles. The parent material is typically light grayish brown, non-calcareous shale till with medium distinct mottles.

Fresno soils occur in close association with Nayler and Fifere soils. Fresno soils were previously mapped as imperfectly drained associates of the Snowflake association in the reconnaissance soil survey of South-Central Manitoba (1943).

Froswick Series (FWK)

The Froswick series is characterized by an Orthic Black profile developed under well to moderately well drained moisture regime on a variable veneer (25 to 90 cm) of moderately to strongly calcareous loamy (loam to clay loam) glacial till of shale, limestone and granitic origin overlying non-to weakly calcareous shale bedrock. These soils occur in association with Black soils on the upper slopes and in various locales where the surface deposits are shallow to shale bedrock. They occur on undulating, hummocky and inclined landscapes with a variable slope class ranging from gentle to steeply sloping. Runoff is moderate to rapid; permeability above the shale bedrock is moderate. Native vegetation consists of mixed tall grass, deciduous trees and shrubs. Most of these soils have been cultivated.

The solum has a very dark gray to black clay loam Ap horizon 15 to 20 cm thick; a brown to dark brown clay loam Bm 15 to 20 cm thick; a calcareous transitional BC horizon 10 to 20 cm thick to the parent material . The underlying shale bedrock may have an altered or softened layer of 15 to 25 cm before the more compact layers are encountered.

The Froswick soils occur in association with Jirose soils. These soils were previously mapped as inclusion within the Blumenstein Complex and transition areas of the Darlingford Association in the South-Central (1943) report.

Gervais Series (GVS)

The Gervais series consists of imperfectly drained Gleyed Cumulic Regosol soil developed on moderately to strongly calcareous, deep, stratified, loamy (SiL,L,SiCL,CL), recent fluvial deposits. Flooding is a hazard where drainage has not been improved. These soils occur in middle positions of very gentle slopes on floodplain landscapes; surface runoff is slow. They have moderately slow to slow permeability; water table is generally below a meter during the growing season. Gervais soils are non-eroded, non-stony, and non-saline. They have high available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes elm, maple, poplar and meadow grasses. The majority of these soils are currently cultivated for crop production.

The profile is characterized by a weakly developed dark gray to gray Ah horizon, 12 to 20 cm thick; and a lighter colored Ck horizon, with stratified FSL and FS textured layers. Dark coloured buried Ah horizons are common.

Gervais soils occur in close association with La Salle, Elm River and Willowbend soils. Gervais soils were previously mapped as associates of the Assiniboine Complex and imperfectly drained member of the Riverdale Association in the Carberry (1957) soil report.

Glencross Series (GCS)

The Glencross series are somewhat poorly or imperfectly drained Gleyed Rego Black (carbonated) soils developed in thin, medium grading to moderately fine textured, moderately to strongly calcareous lacustrine, sediments that overlie strongly calcareous, stony, water-worked glacial till. Shale bedrock may occur below the till at about 1-1.5 m. The change from loamy sediments to stony, loam to clay loam textured till is abrupt and usually occurs at .3 to 1 m below the surface. A gravelly or cobbly lense (<10 cm in thickness) usually occurs at the contact of the unconforming layers. Glencross soils occur in a few scattered small areas on level terrain where runoff is slow and in association with the well drained Roseisle soils.

These slightly to moderately stony soils have thin black to very dark gray Ah horizons that are granular, friable, mildly alkaline in reaction and calcareous; thin transitional, grayish brown, strongly calcareous, moderately alkaline, granular AC horizons; and light gray to light brownish gray, strongly calcareous C horizons having a granular-like structure, friable to slightly hard consistence and numerous faint to distinct, medium to fine sized, brown mottles. Flakes of dark gray shale with white calcium carbonate coatings occur near the contact of the underlying till. The grayish brown to light brownish gray, loamy textured till is granular, moderately alkaline, moderately to strongly calcareous, gypsiferous and stained with brown mottles.

The Glencross soil occurs in association with the Roseisle soils. They were previously mapped as part of the Blumenstein Complex in the South-Central (1943) report.

Glencross, limestone substrata variant (GCS1)

The Glencross variant has similar characteristics to the Glencross series, but has a limestone layer at or near the one meter depth. There is a small area mapped in Section 23, Township 4, Range 6W. The limestone layer is hard and not weathered (as observed along the south end of the map unit). The thickness of this layer and the underlying layer is not known.

Gnadenthal Series (GDH)

The Gnadenthal series consists of imperfectly drained Gleyed Rego Black soil developed on moderately to strongly calcareous, deep stratified, loamy (VFSL,L,SiL), fluvial and lacustrine deposits. These soils occur in middle positions of nearly level to very gentle slopes on undulating landscapes and have moderate permeability, moderately slow surface runoff, and a medium water table during the growing season. Gnadenthal soils are non-eroded, non-stony, and nonsaline. They have a medium available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation includes tall prairie grasses. The majority of these soils are currently cultivated for grain crop production.

The solum is approximately 30 cm thick with a very dark gray to black weakly calcareous Ap horizon, 15 to 40 cm thick; a gray to dark gray AC horizon, 7 to 25 cm thick with moderate calcareousness. Occasionally a Cca horizon, 5 to 10 cm thick is present. The parent material is typically stratified with FSL, SiCL and CL textures and contains iron mottles.

Gnadenthal soils occur in close association with Reinfeld and Blumenfeld soils. Gnadenthal soils were previously mapped as Black Meadow associates of the Rathwell Association in the Carberry (1957) soil report; and imperfectly drained associate of the Altona fine loams in the South-Central (1943) soil report.

Graysville Series (GYV)

The Graysville series consists of imperfectly drained Gleyed Rego Black soil developed on a mantle (60 to 90 cm) of moderately to strongly calcareous, loamy (VFSL,L,SiL,SiCL,CL), fluvial and lacustrine deposits over moderately calcareous, clayey (C,SiC), lacustrine deposits. These soils occur in middle positions of nearly level slopes on undulating landscapes; surface runoff is slow. Permeability is moderate in the loamy overlay and very slow in the clayey substrate. They have a perched water table during the spring and early growing season. Graysville soils are non-eroded, non-stony, and occasionally slightly saline. They have a high available water holding capacity, high organic matter content, and high natural fertility. Native vegetation includes prairie grasses, willows. The majority of these soils are currently cultivated for grain crop production.

The solum is approximately 30 cm thick with a very dark gray Ah horizon, 15 to 40 cm thick; and an AC horizon, 8 to 20 cm thick with moderate calcareousness. The IICk clay horizon, has many distinct mottles and contains gypsum; a Cca horizon, 5 to 8 cm thick may be present.

Graysville soils occur in close association with Denham, Rignold and Edkins soils. Graysville soils were previously mapped as Black Meadow associates of the Rathwell Association in the Carberry (1957) soil report; and as imperfectly drained Altona, heavy substrate in the South-Central (1943) soil report.

Gretna Series (GRA)

The Gretna series is characterized by a Gleyed Solonetzic Black solum, with imperfect soil drainage, and developed on weakly to moderately calcareous, fine to very fine clayey fluvial and lacustrine sediments. They occur at the base of the Escarpment in areas that were affected by the backbeach deposits of Lake Agassiz and subsequent flooding and deposition of fine textured sediments derived from the Cretaceous shales and the associated till. The clayey strata vary in thickness from 1 to 4 m and may be underlain by shale bedrock, glacial till or stratified silty sediments. These soils are in seepage prone areas; soluble salts contain a considerable proportion of sodium ion. Surface runoff is moderately slow; permeability is vary slow, particular in the B horizons with considerable sodium.

The solum has a vary dark gray to black Ah horizon 10 to 15 cm thick with clay that is very sticky when wet, forms hard clods when dry and neutral to mildly alkaline in reaction; a massive very dark gray to black Bnj horizon, 12 to 20 cm thick

with heavy clay texture; and a transitional BC horizon 5 to 15 cm thick. The massive B horizon breaks as weak subangular blocky fragments that have a curved or concoidal edges when moist; it forms hard irregular blocks or clods when dry and are difficult to break. Under pasture condition, a shallow columnar Bnj1, 10 to 12 cm thick is common and grades into the massive Bnj2; the Ah is commonly 5 cm thick. Under cultivation, this columner structure is broken up and incorporated with the Ap. Gypsum crystals are commonly noted within and below the BC horizon. The gray to olive gray C horizon is calcareous,, usually gypsiferous and has a variable amount of other salts.

The Gretna series occurs within the lower slopes of the Escarpment in association with the Blumengart and Blumenort series. They were previously the imperfectly drained, slightly alkalized Blackearth member of the Gretna Association in the South-Central (1943) report.

Guerra Series (GRR)

The Guerra series consists of poorly drained Rego Humic Gleysol soil developed on a mantle (35 to 100 cm) of moderately to strongly calcareous, uniform, fine loamy (CL, L, SiCL), lacustrine deposits over moderately to strongly calcareous, deep, uniform, fine loamy (CL, L, SiCL), mixed till deposits. These soils occur in level to depressional positions of very gentle slopes on hummocky landscapes; surface runoff is very slow. Permeability is slow. The water table is at the surface in the spring and high during the growing season. They have a medium available water holding capacity, high organic matter content, and low natural fertility. Native vegetation often includes sedges, rushes and willows. The majority of these soils are currently used for natural grazing.

The solum is approximately 25 cm thick with a black Ah or Ahk horizon, 15 to 30 cm thick; a very dark gray transitional AC horizon, 5 to 15 cm thick with many prominent iron mottles. The parent material is relatively free of coarse fragments and has a dark olive gray color with many prominent iron mottles.

Guerra soils occur in close association with Knudson, Joyale and Ullrich soils. Guerra soils were previously mapped as the poorly drained blackearth associate of the Altamont association, in the reconnaissance soil survey of South-Central Manitoba (1943).

Hebbot Series (HEB)

The Hebbot series consists of well drained Rego Black soil developed on strongly to very strongly calcareous, deep, uniform, loamy (L,CL,SiCL), glacial till deposits derived from limestone, granite and shale. These soils occur in upper and crest positions of moderate to strong slopes on hummocky landscapes; surface runoff is moderate. Permeability is moderate to moderately rapid; water table is low during the growing season. Hebbot soils are slightly stony, and non-saline. Native vegetation includes scrub oak, aspen, shrubs and prairie grasses. The majority of these soils are currently cultivated for grain and forage production.

The profile is characterized by a dark gray to very dark gray Ah horizon, 10 to 15 cm thick; a brown to pale brown Cca horizon, 10 to 15 cm thick; and a yellowish brown Ck horizon.

Hebbot soils occur in close association with Darlingford, Nikkel and Cazlake soils. Hebbot soils were previously mapped as Calcareous Black associates of the Darlingford Association in the South Central (1943) soil report.

Hibsin Series (HIN)

The Hibsin series consists of moderately well drained Orthic Black soil developed on a mantle (40 to 90 cm) of weakly to moderately calcareous, shallow, coarse loamy (LVFS,VFS,FSL), lacustrine deposits over moderately calcareous, uniform, deep, clayey (SiC,C), lacustrine deposits. These soils occur in upper positions of very gentle slopes on undulating landscapes; surface runoff is moderate. Permeability is moderately rapid in the coarse loamy sediments and slow to very slow in the underlying clayey deposits. Hibsin soils are non-eroded, non-stony, and non-saline. They have a medium available water holding capacity, high organic matter content, and high natural fertility. Native vegetation includes aspen, oak, shrubs and prairie grasses. The majority of these soils are currently cultivated for grain crop production.

The solum is approximately 40 cm thick with a very dark gray to dark gray Ah horizon, 15 to 25 cm thick; and a brown Bm horizon, 20 to 30 cm thick. A Cca horizon, 8 to 13 cm thick with lime accumulation is usually present if the sandy loam sediments are greater than 60 cm thick. The solum is usually developed entirely in the coarser material.

Hibsin soils occur in close association with Rosebank and Layland soils. Hibsin soils were previously mapped as associates of the Almasippi clay substrate Association in the Carberry (1957) soil report.

Hochfeld Series (HHF)

The Hochfeld series consists of moderately well drained Orthic Black soil developed on moderately calcareous, coarse loamy (VFS,LVFS,FSL,SL), lacustrine deposits. These deposits range in thickness from 1.5 to 5 meters over finer textured lacustrine sediments. These soils occur in upper positions of very gentle slopes on undulating landscapes; surface runoff is moderate. They have moderately rapid permeability and a low water table during the growing season. Hochfeld soils are often slightly eroded, non-stony, and non-saline. They have a medium available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation includes tall prairie grasses. The majority of these soils are currently cultivated for grain crop production.

The solum is approximately 50 cm thick with a dark gray to very dark gray Ah horizon, 15 to 25 cm thick; a brown Bm horizon, 15 to 40 cm thick. The unaltered parent material (Ck) is brown with many faint mottles, usually a light brown Cca horizon, 5 to 8 cm thick is present.

Hochfeld soils occur in close association with Reinland and Osterwick soils. Hochfeld soils were previously mapped as Blackearth associates of the Almasippi Association in the Carberry (1957) soil report; and moderately well drained associate of the Altona Association in the South-Central (1943) soil report.

Horndean Series (HND)

The Horndean series is a Gleyed Black soil developed on imperfectly drained, moderately to strongly calcareous, clayey (SiC, C) sediments overlying sandy to loamy stratified fluvial and lacustrine sediments,

that range in texture from fine sand to silty clay loam. These soils occur in the western section of the Red River Plain on level to very gently sloping terrain in association with Dugas and Jordan soils. Surface runoff is slow. Permeability is moderately slow to slow in the clayey sediments and moderate in the underlying sandy to loamy sediments; downward movement of water can be restricted during the spring by a high water table.

The Horndean soil profile has a granular structured, black to very dark gray Ah horizon, 20 to 30 cm thick, that is plastic and sticky when wet; very firm when moist and very hard when dry; a very dark brown to very dark grayish brown Bm horizon, 15 to 25 cm thick, having blocky structure, plastic and sticky consistence when wet, and a thin transitional BC horizon. This transitional horizon grades to a grayish brown Cgj horizon that is granular in structure, firm when moist, distinctly mottled and gypsiferous, particularly near the contact of the clayey and sandy materials. The underlying sediments are stratified, usually saline and mottled.

The Hordean soils are associated with Dugas and Jordan soils. They were previously mapped as the imperfectly drained Meadow-prairie soils of the Morden Association of the South-Central (1943) report; and the intermediately drained mature soils of the Horndean Complex of the Winnipeg-Morris (1953) report.

Horose Series (HOS)

The Horose series consists of poorly drained Rego Humic Gleysol soil developed on moderately to strongly calcareous, deep, uniform, fine loamy and coarse loamy (L, CL, SICL) mixed till of limestone, granite and shale origin. These soils occur in level to depressional positions of moderate slopes on hummocky landscapes; surface runoff is very slow to ponded. Permeability is very slow; a water table is at the surface in the spring and within a meter during the growing season. Horose soils are non-eroded, slightly stony and slightly saline. They have medium available water holding capacity, high organic matter content, and low natural fertility. Native vegetation often includes sedges, reeds and willows. The majority of these soils are currently under natural conditions.

The solum is approximately 25 cm thick with a black Ah or Ahk horizon, 20 to 35 cm thick; a light olive brown AC horizon, 5 to 10 cm thick. The unaltered parent material (Ck) is a light yellowish brown with many, large, prominent iron mottles. A Cca horizon, 5 to 10 cm thick below the AC horizon is usually present.

Horose soils occur in close association with Dezwood, Pembina and Zaplin soils. Horose series differs from the closely similar Caslake soils mainly by association with Dark Gray Pembina soils rather than Black soils of the Darlingford Association. Horose soils were previously mapped as poorly drained associates of the Pembina association, in the reconnaissance soil survey of South-Central Manitoba (1943).

Jasset Series (JST)

The Jasset series consists of imperfectly drained Gleyed Black soil developed on a mantle (70 to 90 cm) of moderately to strongly calcareous, shallow loamy (VFSL,L,SiL,SCl), lacustrine deposits over moderately calcareous, stratified, deep, sandy (FS,LFS,VFS) lacustrine deposits.

These soils occur in middle positions of very gentle slopes on undulating landscapes; surface runoff is slow. Permeability is moderate in the upper loamy material and moderately rapid in the sandy substrata; water table is below a meter during the growing season. Jasset soils are non-eroded, non-stony, and non-saline. They have medium available water holding capacity, high organic matter content, and medium natural fertility. Native vegetation includes tall prairie grasses. The majority of these soils are currently cultivated for grain crop production.

The solum is approximately 60 cm thick with a very dark gray to black Ap horizon, 25 to 35 cm thick; a brown to yellowish brown Bm horizon, 25 to 40 cm thick with fine, faint mottles; a carbonated BC horizon, 10 to 15 cm thick. A Cca horizon, 5 to 10 cm thick is usually present below the solum.

Jasset soils occur in close association with Neuenberg and Rosengart soils. Jasset soils were previously mapped as Black Meadow associates of the Almasippi Association in the Carberry (1957) soil report; and imperfectly drained associate of the Altona Association in the South-Central (1943) soil report.

Jirose Series (JIS)

The Jirose Series is characterized by a Gleyed Rego Black carbonated profile developed under an imperfect moisture regime on a variable veneer (25 to 90 cm) of moderately to very strongly calcareous, loamy (loam to clay loam) glacial till of shale, limestone and granitic origin. The till is underlain by non to weakly calcareous shale bedrock. These soils occur in association with Black soils in various locales where the surface deposits are shallow to shale bedrock. They occur on the lower slopes; some seepage from upslope and salinity may be present. Surface runoff is moderate, but internal drainage and permeability may be restricted for a considerable period during spring and summer. Most areas have been cultivated.

The solum has a carbonated, very dark gray to black Ap horizon 15 to 20 cm thick and an Ah horizon 10 to 20 cm; a gray to grayish brown transitional AC horizon 5 to 15 cm may be present. Gypsum crystals are common in the C horizon. The underlying shale bedrock may have a weathered or softened layer of 15 to 25 cm before the more compact layers are encountered.

The Jirose soils are associated with the Froswick soils. The soils were previously mapped as inclusions within the Blumenstein Complex and transitional areas to the Darlingford Association in the South-Central (1943) report.

Jordan Series (JOD)

The Jordan series is characterized by an Orthic Black soil developed on moderately well drained, thin moderately to strongly calcareous, clayey sediments abruptly grading to calcareous stratified sandy (FS, LFS, LS) to loamy (VFSL, L, SiL, VFS, LVFS) lacustrine sediments at a depth of 60 to 100 cm. The soils occur in the western section of the Red River Plain on level to very gently sloping terrain in association with Horndean and Dugas soil series. Surface runoff is moderately slow to slow. Permeability of the clayey sediments is moderately slow to very slow, whereas subsoil permeability is moderate to moderately rapid.

The Jordan soil profile has a very dark gray to black Ah horizon, 15 to 35 cm thick; a dark grayish brown Bm horizon, 20 to 30 cm thick with subangular blocky structure. The B horizon commonly extends to the contact of the coarser sediments. The strongly contrasting IICk horizon is stratified, variable in texture, and has numerous, faint iron mottles.

The Jordan soils occur in association with the Dugas and Horndean soils. The soils were previously mapped as the well to intermediately drained wooded and Blackearth member of the Morden, shallow phase sand substrate of the South-Central (1943) report.

Joyale Series (JYL)

The Joyale series consists of imperfectly drained Gleyed Rego Black soil developed on a mantle (25 to 100 cm) of moderately to strongly calcareous, uniform, fine loamy (L, CL, SICL), lacustrine sediments over moderately to very strongly calcareous, deep uniform, fine loamy (CL, SICL), mixed till deposits. These soils occur in lower slope positions of very gentle slopes on undulating landscapes; surface runoff is slow. Permeability is moderate and water table is usually between 1 to 2 m during the growing season. Joyale soils are usually non-saline. They have a medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes tall prairie and meadow grasses. The majority of these soils are currently used for grain crop production.

The solum is approximately 25 cm thick; and is characterized by a very dark gray to black Apk or Ahk horizon, 15 to 25 cm thick and a light gray Cca or AC horizon, 5 to 15 cm thick with distinct iron mottles. The IICk horizon is very pale brown with many prominent iron mottles. A thin pebble line is common at the lacustrine/till contact.

Joyale soils occur in close association with Knudson, Ullrich and Guerra soils. Joyale soils were previously mapped as minor, imperfectly drained blackearth associates of the Altamont association in the reconnaissance soil survey of South-Central Manitoba (1943).

Kerran Series (KRN)

The Kerran series consists of poorly to very poorly drained Rego Humic Gleysol soil developed on moderately to strongly calcareous, deep, stratified, clayey (SiC,C), recent alluvial deposits with strata of silty clay loam and clay loam textures. These soils occur in depressional positions of level slopes on flood-prone terraced landscapes; surface runoff is very slow. Permeability is very slow; water table remains within a meter during the growing season. Kerran soils are non-eroded, non-stony, and non-saline. They have a high available water holding capacity, high organic matter content, and low natural fertility. Native vegetation includes reeds, rushes, sedges and willows. The majority of these soils are currently in native vegetation.

The profile is characterized by a thin organic horizon, 2 to 4 cm thick; a weakly developed dark gray Ahk horizon, 10 to 15 cm thick; and a pale brown to light gray C horizon, with prominent iron mottles. The parent material is typically stratified, mottled, and may contain buried former Ah horizons.

Kerran soils occur in close association with Assiniboine soils. Kerran soils were previously mapped as

associates of the Assiniboine Complex in the Carberry (1957) soil report, and poorly drained members of the Neelin Association of the South-Central (1943) soils report.

Kingsley Series (KIS)

The Kingsley series consists of moderately well to well drained Orthic Dark Gray Luvisol soil developed on a mantle (25 to 100 cm) of weakly to moderately calcareous, uniform, fine loamy (CL, SiCL), lacustrine sediments over moderately to strongly calcareous, deep, uniform, fine loamy (CL, L), mixed till deposits. These soils occur in upper slope positions of very gentle slopes on hummocky landscapes; they have moderate surface runoff. Permeability is moderate, and water table is greater than 2 meters during the growing season. Kingsley soils may be slightly water eroded. They have a medium available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation often includes forest cover of bur-oak and aspen. The majority of these soils are currently used for grain crop production.

The solum is approximately 60 cm thick with a grayish brown Ahe or Ap horizon, 10 to 20 cm thick; a light gray Ae horizon, 10 to 15 cm thick with fine platy structure; a light yellowish brown, transitional AB horizon, 10 to 25 cm thick; a pale brown Bt horizon, 5 to 15 cm thick with clay skins; a light yellowish brown transitional IIBC horizon, 10 to 20 cm thick. The till substrate is very pale brown, materials of shale, limestone and granitic origin but can also be a dominance of shale in some areas.

Kingsley soils occur in close association with Altamont soils. Kingsley soils were previously mapped as Gray-Wooded associates of the Altamont association in the reconnaissance soil survey of South-Central Manitoba (1943).

Klidal Series (KDA)

The Klidal series is characterized by a Gleyed Solonetzic Black solum, developed on a veneer (25 to 90 cm) of non to weakly calcareous clayey deposits or weathered (altered) shale overlying non to weakly calcareous shale bedrock. These soils are imperfectly drained and occur in the lower to mid slope positions in association with Benton soils in the Escarpment area and various locales above the escarpment. These soil areas are not extensive. Slopes are generally very gently sloping; runoff is moderate to slow; and some seepage from upslope position may occur. Permeability is very slow to negligeable because of the massive soil structure in the lower B and the C horizon.

The solum has a very dark gray to black Ap or Ah horizon 20 to 25 cm thick; a weak columnar grading to massive Bnj 15 to 25 cm thick. A massive Cg or weakly calcareous Ckg changes gradually through softened or altered shale to the firm shale bedrock. Gypsum crystals and jarosite may be present in the weakly oxidized upper layers of softened or altered shales.

The Klidal soils occur in close association with the Brundis and Bishop soils. They were previously recognized as the imperfectly drained alkalinzed Gray-Black members of the Benton Association in the South-Central (1943) report.

Knudson Series (KUD)

The Knudson series consists of moderately well to well drained Orthic Black soil developed on a shallow mantle (30 to 100 cm) of weakly to moderately calcareous uniform, fine loamy to clayey glaciolacustrine deposit, over moderately to strongly calcareous, deep, uniform, fine loamy to fine silty mixed till deposits. These soils occur in middle positions of very gentle slopes on undulating landscape; surface runoff is moderate. Permeability is medium; water table is greater than 2 m during the growing season. Knudson soils have moderate available water holding capacity, moderate organic matter content, and high natural fertility.

The solum is approximately 60 cm thick with a black Ap horizon, 15 to 25 cm thick; a brown to grayish brown Bm horizon 8 to 12 cm thick with medium subangular blocky structure. A very pale brown Cca horizon 6 to 10 cm thick occurs above a yellowish brown IICk horizon. A thin pebble line commonly occurs at the lacustrine-till interface.

Knudson soils occur in close association with Joyale and Guerra soils. Knudson soils were previously mapped as Blackearth associates of the Altamont association in the reconnaissance soil survey of South-Central Manitoba (1943).

Kronstal Series (KOT)

The Kronstal series consists of imperfectly drained Gleyed Black soil developed on moderately calcareous, deep, stratified, coarse loamy (VFS,LVFS,FSL,SL), lacustrine deposits. These soils occur in middle positions of nearly level slopes on undulating landscapes and have moderately slow surface runoff. Permeability is moderately rapid to moderate; and a water table is between 1 to 2 m during the growing season. Kronstal soils are non-eroded, non-stony, and non-saline. They have a medium available water holding capacity, high organic matter content, and medium natural fertility. Native vegetation includes tall prairie grasses. The majority of these soils are currently cultivated for grain crop production.

The solum is approximately 55 cm thick with a very dark gray Ah horizon, 20 to 30 cm thick; and a grayish brown to brown Bm horizon, 20 to 40 cm thick with fine to medium yellowish mottle. The parent material is stratified with layers of FS to LFS texture and has distinct mottles. A Cca horizon, 8 to 13 cm thick, commonly occurs below the solum.

Kronstal soils occur in close association with Hochfeld, Reinland and Osterwick soils. They are similar to Jasset soils by having a Gleyed Black profile and coarse loamy substrate but differ from them in lacking a loamy surface mantle. Kronstal soils were previously mapped as Black Meadow associates of the Almasippi Association in the Carberry (1957) soil report; and one of the imperfectly drained members of the Altona Association in the South-Central (1943) soil report.

La Salle Series (LSL)

The La Salle series is characterized by Cumulic Humic Regosol soil, developed on materials of moderately to strongly calcareous loamy (L, SiL, SiCL, CL) stratified recent fluvial sediments. These soils are moderately well drained and occur in the western part of the Red River Plain on gently sloping to irregular topography in upper terraces, levees and meander scrolls along the Elm, La Salle and Boyne Rivers. These soils

are subject to occasional flooding during periods of exceptional stream flows. Runoff is moderate; permeability is moderate. Native vegetation consists dominantly of deciduous trees, elm, ash, basswood and Manitoba maple and some tall prairie grasses.

The profile has a weakly developed dark gray Ah horizon that is somewhat darker than the C horizon. The underlying materials are stratified with dominantly silt loam to silty clay loam textures and thin strata of very fine sand, fine sand or silty clay. In some areas, the solum in the moist state appears to have development of a Bmk with weak blocky structure.

The La Salle soils occur in association with the Gervais and Willowbend soils. They were previously included as better drained immature alluvial members of the Riverdale Association in the South-Central (1943) and Winnipeg-Morris (1953) reports.

Layland Series (LAY)

The Layland series consists of poorly drained Rego Humic Gleysol soil developed on a mantle (30 to 90 cm) of strongly calcareous, stratified, shallow, sandy (FS,LFS) to coarse loamy (VFS,LVFS,FSL), deposits over moderately calcareous, uniform, deep, clayey (SiC,C), lacustrine deposits. These soils occur in depressional positions of nearly level slopes on undulating landscapes; surface runoff is very slow to ponded. Permeability is moderately rapid in the sandy to coarse loamy strata and very slow in the underlying clay substrata; water table is within a meter during the growing season. Layland soils are non-eroded, non-stony, and often slightly saline. They have medium available water holding capacity, high organic matter content, and low natural fertility. Native vegetation includes sedges, rushes, seeds and willows. The majority of these soils are currently in native vegetation.

The solum is approximately 25 cm thick with a very dark gray Ah horizon, 15 to 35 cm thick, with moderate calcareousness; underlain by an AC horizon, 7 to 20 cm thick with moderate calcareousness; a peaty surface layer 5 to 15 cm thick, is present at the surface. A Cca horizon, 5 to 8 cm thick occurs below the solum.

Layland soils occur in close association with Hibsin, Rosebank and Elm Creek soils. Layland soils were previously mapped as associates of Almasippi clay substrate Association in the Carberry (1957) soil report.

Leary Series (LRY)

The Leary series consists of well to rapidly drained Orthic Dark Gray soil developed on moderately to strongly calcareous, deep, stratified, sandy to sandy-skeletal (LCS, GrLS), glaciofluvial and lacustrine beach deposits. These soils occur in middle to upper slope positions of moderate slopes on hummocky and ridged landscapes; surface runoff is moderate. Permeability is very rapid; and the water table is below 2 m during the growing season. Leary soils have low available water holding capacity, low organic matter content, and low natural fertility. Native vegetation consists of forest cover of dominantly bur oak. Extensive areas of these soils are currently excavated for road construction and the aggregate industry.

The solum is approximately 50 cm thick with a dark gray Ah or Ap horizon, 10 to 20 cm thick; a dark brown

Bt or Btj horizon, 5 to 20 cm thick; and a brown transitional BC horizon, 15 to 30 cm thick. The Ck is light yellowish brown.

Leary soils were previously mapped as the dominant associate of the Leary association in the reconnaissance soil survey of South-Central Manitoba (1943).

Lelant Series (LLT)

The Lelant series consists of poorly drained Rego Humic Gleysol soil developed on moderately to strongly calcareous, deep, uniform, sandy (FS,LFS,LS), lacustrine deposits. These soils occur in level to depressional positions, often behind lowbeach ridges; surface runoff is very slow to ponded. Water table is above the surface in the spring and within a meter during the growing season. Lelant soils are non-eroded, non-stony, and frequently slightly saline. They have a low available water holding capacity, high organic matter content, and low natural fertility. Native vegetation includes reeds, sedges, rushes and willows. The majority of these soils are currently in native vegetation.

The solum is approximately 25 cm thick with a moderately decomposed surface organic horizon, 5 to 10 cm thick; a very dark gray to black Ah horizon, 8 to 15 cm thick; a transitional AC horizon, 5 to 10 cm thick. A Cca horizon, 5 to 8 cm thick is frequently present below the solum.

Lelant soils occur in close association with Skelding, Longplain and Almasippi soils. Lelant soils were previously mapped as Meadow associates of the Almasippi Association in the Carberry (1957) soil report; and poorly drained members of the Almasippi Association in the South-Central (1943) soil report.

Levine Series (LEI)

The Levine series consists of imperfectly drained Gleyed Cumulic Regosol soil developed on moderately to strongly calcareous, deep, stratified, coarse loamy to fine loamy (VFSL, L, CL) recent alluvial deposits. These soils occur in flood plains on level slopes in level landscapes; surface runoff is moderately slow. Permeability is moderate generally, but may vary from moderately rapid to moderately slow; water table is at 1 to 2 m during the growing season. Levine soils are non-saline. They are subject to periodic inundation during spring runoff or after heavy rains. They have a moderate available water holding capacity, moderate organic matter content and medium natural fertility. The majority of these soils are currently used for grain crop production.

The profile is characterized by a dark gray Apk or Ahk horizon 10 to 20 cm thick and a light yellowish brown Ck horizon. The underlying strata may vary in colour from light to dark. The thin dark colored mineral and organic layers are former surface horizons that have been exposed to soil forming processes for a significant period before burial by alluvial deposits. Medium, distinct yellowish brown iron mottles occur through the soil.

Levine soils were previously mapped as inclusions of Eroded Slope Complexes in the reconnaissance soil survey of South-Central Manitoba (1943) soil report.

Loewen Series (LEW)

The Loewen series consists of poorly drained Rego Humic Gleysol soil developed on non to weakly calcareous, stratified, loamy (CL,L,) fluvial deposits derived from till and shale materials. These soils occur in depressional positions of gentle slopes on flood prone landscapes; surface runoff is very slow or ponded. Water table is within 1 m during the growing season. Loewen soils are non-eroded, non-stony, and frequently slightly saline. They have a medium available water holding capacity, medium organic matter content, and low natural fertility. Native vegetation includes sedges, reeds, rushes and willows. The majority of these soils are currently in native vegetation.

The profile is characterized by a mixed peaty-mineral surface horizon, 10 to 15 cm thick; a thin, carbonated Ah horizon, 5 to 15 cm thick; and a olive gray Ckg horizon, with variable textures; buried surface layers at various depth are common.

Loewen soils occur in close association with Chortitz soils. Loewen soils were previously mapped as associates of the Assiniboine Complex in the Carberry (1957) soil report, and poorly drained members of the Morden Association is the South-Central (1943) soil report.

Long Plain Series (LOP)

The Long Plain series consists of imperfectly drained Gleyed Regosol soil developed on weakly to moderately calcareous, deep, uniform, sandy (LFS,FS), wind-modified, deltaic deposits. These soils occur in middle positions of gentle slopes on undulating landscapes; surface runoff is moderately slow. Permeability is rapid; water table is approximately 1 m in the spring and 1.5 to 1.8 m during the growing season. Long Plain soils are affected by wind erocion, and are non-stony, and non-saline. They have a low available water holding capacity, low organic matter content, and low natural fertility. Native vegetation includes scrub oak, aspen, shrubs and prairie grasses. The majority of these soils are currently used for cereal crop and forage production.

The profile is characterized by a dark gray to gray Ap horizon, 10 to 25 cm thick; a carbonate-free C horizon, 60 to 90 cm thick; and a calcareous C horizon, with prominent mottles. A dark gray layer, 5 to 15 cm thick may be present within a meter of the surface.

Long Plain soils occur in close association with Skelding, Almasippi and Lelant soils. Long Plain soils were previously mapped as associates of the Almasippi Association in the Carberry (1957) and South Central (1943) soil report.

Mansfield Series (MFI)

The Mansfield series consists of imperfectly drained Gleyed Rego Black soil developed on moderately to strongly calcareous, stratified, deep, sandy skeletal (S,GrS,CS), glaciofluvial deposits. These soils occur in middle positions of nearly level slopes on level landscapes; surface runoff is moderately slow. Permeability is rapid and the water table is at approximately 1 m in the spring and 1.5 to 1.8 m during the growing season. They have a low available water holding capacity, medium organic matter content, and low natural fertility. Native vegetation includes prairie grasses, shrubs and aspen. The majority of these soils are currently used for grazing or forage crops.

The solum is approximately 20 cm thick with a very dark gray Ah horizon, 15 to 15 cm thick; a dark gray to grayish brown AC horizon, 8 to 15 cm thick, with moderate calcareousness. A Cca horizon, 5 to 8 cm thick is usually present below the solum.

Mansfield soils occur in close association with Birkenhead, Agassiz and Fortina soils. They differ from Agassiz and Birkenhead soils in having no Bm horizon and from Fortina soils because of better drainage. Mansfield soils were previously mapped as associates of the Marringhurst and Agassiz Associations in the South-Central or Carberry soil reports.

Manitou Series (MXS)

The Manitou series consists of well drained Orthic Black soil developed on weakly calcareous to neutral, deep, uniform, fine loamy and fine silty (CL, L, SiL) glacial till derived predominantly from shale bedrock deposits. These soils occur in middle and upper positions of very gentle slopes on undulating landscapes; surface runoff is moderate. Permeability is moderate; water table is usually below 2 m during the growing season. Manitou soils are non-eroded and non-stony. They have medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes tall prairie grasses interspersed with aspen-oak groves. The majority of these soils are currently used for grain crop production.

The solum is approximately 75 cm thick with a very dark gray Ap or Ah horizon, 15 to 20 cm thick, with fine shale flakes; a dark gray Bm horizon, 20 to 60 cm thick; a transitional BC horizon, 10 to 15 cm thick. The parent material is a light gray non-calcareous till derived from shale.

Manitou soils occur in close association with Fifere and Darlingford soils. They differ from the Fifere soils because of lack of a Bt horizon. Manitou soils were previously mapped as the dominant associate of the Manitou association in the reconnaissance soil survey of South-Central Manitoba (1943).

Marringhurst Series (MRH)

The Marringhurst series consists of moderately well to well drained Calcareous Black soil developed on moderately strongly to strongly calcareous, stratified, deep, sandy (CS,S,LS) and sandy skeletal (GrS,GrCS) glaciofluvial deposits. These soils occur in upper positions of very gentle slopes on rolling to hummocky landscapes; surface runoff is moderate. Permeability is rapid; water table is greater than 2 m during the growing season. Marringhurst soils are affected by erosion, non-stony, and non-saline. They have a low available water holding capacity, low organic matter content, and low natural fertility. Native vegetation includes shrubs, bur oak, and prairie grasses. The majority of these soils are currently excavated for gravel or used for grazing.

The solum is approximately 25 cm thick with a very dark gray to very dark grayish brown Ah horizon, 14 to 18 cm thick, a dark brown to brown Bmk horizon, 10 to 18 cm thick. A Cca horizon, 20 to 30 cm thick with coarser gravelly strata occurs above the Ck horizon.

Marringhurst soils occur in close association with Dexter and Fortina soils. Marringhurst Association soils were previously mapped as the

dominant associate of the Marringhurst in the Carberry (1957) soil report.

Marsh Complex (MHC)

The Marsh complex consists of very poorly drained, Rego Gleysol carbonated soils developed on lacustrine clay or thin mucky loam deposits over extremely calcareous till and/or moderately calcareous clay. These soils occur on level to depressional areas that are covered with water and are usually saturated for most of the year. The native vegetation consists entirely of reeds and sedges.

These soils have a thin surface layer of either muck or mineral material high in organic matter content and are underlain by strongly gleyed, olive gray mineral materials. A very thin Ahg horizon, less than 2.5 cm thick, may be present below the muck surface layer.

Marsh soils are undifferentiated with respect to texture and composition of their parent material. They also are much more poorly drained than other Gleysolic soils.

Morris Series (MRS)

The Morris series consists of imperfectly drained Gleyed Solonetzic Black soils developed on moderately to strongly calcareous clayey lacustrine deposits. They occur on level to very gently sloping topography usually adjacent to or intermediate between poorly drained Osborne clay soils and the imperfectly drained Red River or Scanterbury clay soils; runoff is moderately slow to slow. Permeability is very slow and restricted by the columnar and fine subangular blocky to massive, B horizon comprised of high swelling clay.

In the virgin state, these soils have a shallow dark gray to gray Ah or Ahej horizon 5 to 8 cm thick, a dark gray to gray columnar Bn horizon 10 to 15 cm thick and an amorphous dark gray to black, waxy Bn2 horizon that breaks into coarse subangular blocky peds. Gypsum may be present in the olive gray to grayish brown weakly mottled C horizon. Under cultivation, most of the columnar Bn1 horizon is incorporated with the Ap horizon. In the moist condition, the Ap is cloddy and breaks under pressure into weak, medium to fine granular peds; in the dry condition, the Ap is cloddy and hard, and breaks with difficulty into coarse clods or rounded blocks. Weakly saline conditions are common in the subsoil.

The Morris soils occur in association with the Red River and Osborne soils. They were previously mapped as inclusions of Solonetzic Black-Meadow associates of the Red River Association in the Carberry (1957) report; intermediately drained alkalinized associate of the Red River Association in the South-Central (1943) report; and the alkalinized associate of the Red River Association in the Winnipeg-Morris (1953) report.

Mowbray Series (MOW)

The Mowbray series consists of well drained Cumulic Regosol soil developed on deep, moderately to strongly calcareous, loamy (L, SiL, CL, SiCL) recent alluvial sediments. These deposits are stratified and contain dark colored bands of former Ah horizons in the profile. The soils are located in upper terraces of flood plains that have been inundated during years of high flood waters. They occur in association with the Levine and Basker soils. Topography is very gently to moderately sloping; surface runoff is moderate and permeability is moderate.

The soil is characterized by a dark gray to gray surface horizon (Ah or Ap) 8 to 20 cm thick and a lighter colored (C) substratum with dark bands consisting of former organic layers or buried Ah horizons. These soils may exhibit weak development of dark or coloured surface horizons.

Mowbray soils occur in close association with the Levine and Basker series. They were previously mapped as the moderately well drained member of the Neelin Association in the South-Central (1943) and Assiniboine Complex in the Carberry (1951) soil reports.

Myrtle Series (MYT)

The Myrtle series consists of well to moderately well drained Orthic Black soils developed on moderately to strongly calcareous clayey lacustrine deposits. The surface texture ranges from silty clay to clay. The topography is very gently to gently sloping; surface runoff is moderate. Permeability is moderate in the solum due to granular structure, but moderately slow to slow at greater depths.

The solum has a deep dark gray Ah horizon 30 to 45 cm thick, with friable fine granular structure; a dark brown to dark grayish brown Bm horizon, 25 to 40 cm thick, with moderate medium prismatic breaking to medium granular structure. The C horizon is light brownish gray to pale brown and has a pseudosubangular blocky structure.

The Myrtle soil is differentiated from the Scanterbury soil by a deeper, friable Ah horizon, brighter chroma in the B horizon and absence of mottles in the B or upper part of the C horizon. These soils were included as the moderately well to well drained member of the Red River Association in the South-Central (1943) soil report.

Nanton Series (NTO)

The Nanton series is characterized by a Gleyed Black solum, imperfect soil drainage, and materials of shallow (less than 90 cm) loamy (VFSL, L, SiL, CL, SiCL) moderately to strongly calcareous fluvial and lacustrine sediments overlying strongly calcareous water modified glacial till. The change from the loamy strata to the water modified till is abrupt; a gravelly or cobbly strata usually occurs at the contact. Nanton soils occur in the western part of the Red River Plain, on lower slopes of the Escarpment area and some areas along the Pembina River Valley. Weakly calcareous shale bedrock may be present at depths of 1 to 1.5 m below the surface. Surface runoff is slow. Some seepage may occur along the shale bedrock or the modified till. Permeability is moderate in the upper loamy strata and slow in the underlying till and shale bedrock.

The solum has a very dark gray Ah horizon 6 to 15 cm thick; a dark grayish brown Bmgj horizon 10 to 14 cm thick; and a transitional BC horizon of variable thickness; the solum depth commonly varies with the thickness of the loamy overlay. A light gray lime accumulation layer (Cca) 5 to 8 cm thick may be present at the contact of the lacustrine and till sediments. The underlying till is a light olive brown with distinct yellowish brown mottles.

The Nanton soils occur in association with the Roseisle and Glencross soils. They were previously included as the imperfectly drained Blackearth members of the Blumenstein Complex of the South-Central (1943) report.

Neuenberg Series (NBG)

The Neuenberg series consists of imperfectly drained Gleyed Rego Black soil developed on a mantle (70 to 90 cm) of moderately to strongly calcareous, shallow, loamy (VFSL,SCL,L,SiL), fluvial and lacustrine deposits over moderately calcareous, stratified, deep, coarse loamy (LFS,FS,VFS,LVFS), lacustrine deposits. These soils occur in middle positions of nearly level to very gentle slopes on undulating landscapes; surface runoff is moderate to moderately slow. Permeability is moderate in the loamy strata and rapid in the coarser substrata. Water table is between 1 to 2 m during the growing season. Neuenberg soils are non-eroded, non-stony, and often slightly saline. They have a medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes tall prairie grasses. The majority of these soils are currently cultivated for crop production.

The solum is approximately 30 cm thick with a very dark gray Ah horizon, 15 to 25 cm thick, with moderate calcareousness; and an AC horizon, 10 to 20 cm thick. Frequently a Cca horizon, 5 to 8 cm thick, occurs below the solum. The parent material has many distinct mottles, and strata of VFSL,L and SCL textures grading to L, VFS and FS with depth.

Neuenberg soils occur in close association with Rosengart, Jasset and Reinland soils. Neuenberg soils were previously mapped as Black Meadow associates of the Almasippi Association in the Carberry (1957) soil report and is imperfectly members of the Altona Association in the South-Central (1943) soil report.

Neuhorst Series (NUH)

The Neuhorst series consists of imperfectly drained Gleyed Rego Black soil developed on moderately calcareous, deep, uniform, fine loamy (SCL,CL,SiCL), fluvial and lacustrine deposits. These soils occur in middle positions of nearly level to very gentle slopes on undulating landscapes; surface runoff is slow. Permeability is slow and the water table occurs between 1 to 2 m during the growing season. Neuhorst soils are non-eroded, non-stony, and usually non-saline. They have a medium available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation includes tall prairie grasses, prairie-meadow grasses and shrubs. The majority of these soils are currently cultivated for grain crop production.

The solum is approximately 30 cm thick with a very dark gray Ah horizon, 25 to 40 cm thick with weak calcareousness; and a dark gray to gray AC horizon, 8 to 20 cm thick. Frequently a light gray Cca horizon, 10 to 15 cm thick with lime accumulation is present below the solum. The C horizon is light gray to pale yellow with many distinct mottles. Gypsum crystals are common below the AC or Cca horizon.

Neuhorst soils occur in close association with Eigenhof soils. Neuhorst soils were previously mapped as Black Meadow associates of the Rathwell Association in the Carberry (1957) soil report; and imperfectly drained members of the Altona heavy Association in the South-Central (1943) soil report.

Newton Siding Series (NWN)

The Newton Siding series consists of imperfectly drained Gleyed Rego Black soil developed on a mantle (40 to 90 cm) of moderately to strongly calcareous, shallow fine loamy (SCL,CL,SiCL), fluvial and lacustrine deposits over moderately calcareous, stratified, deep, sandy (LFS,FS), fluvial and lacustrine deposits. These soils occur in middle positions of nearly level slopes on undulating landscapes and have moderately slow over moderately rapid permeability, slow surface runoff, and a high water table during the growing season. Newton Siding soils are non-eroded, non-stony, and occasionally slightly saline. They have a medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes prairie-meadow grasses, shrubs and tall-prairie grasses. The majority of these soils are currently cultivated for crop production.

The solum is approximately 30 cm thick with a very dark gray Ah horizon, 25 to 40 cm thick, with weak calcareousness; a gray AC horizon, 8 to 20 cm thick with moderate calcareousness. A Cca horizon, 10 to 15 cm thick is often present. The IICk horizon has prominent mottles.

Newton Siding soils occur in close association with Edenburg soils. Newton Siding soils were previously mapped as inclusions of the Rathwell Association in the Carberry (1957) soil report. In the South-Central (1943) report, they were mapped as imperfectly drained inclusions in the Altona heavy Association.

Nikkel Series (NKK)

The Nikkel series consists of imperfectly drained Gleyed Black soil developed on moderately to strongly calcareous, deep, uniform, fine loamy to coarse loamy (L, CL, SICL), mixed till deposits of granite, limestone and shale origin. These soils occur in lower slope positions of gentle slopes on hummocky landscapes; surface runoff is moderately slow. Permeability is moderately slow; water table is at 1 to 2 m during the growing season. Nikkel soils are non-eroded, slightly stony and usually non-saline. They have a medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes tall prairie and meadow grasses. The majority of these soils are currently used for grain crop production.

The solum is approximately 45 cm thick with a black Ap or Ah horizon, 20 to 25 cm thick; and a dark grayish brown Bm horizon, 5 to 15 cm thick with many, faint, fine iron mottles. A light gray Cca horizon, 5 to 10 cm thick of lime accumulation is commonly present. The Ck horizon is pale brown with many, fine, distinct iron mottles, and is relatively stone-free.

Nikkel soils occur in close association with Darlingford, Ferris and Cazlake soils. Nikkel soils were previously mapped as imperfectly drained Blackearth associates of the Darlingford association in the reconnaissance soil survey of South-Central Manitoba (1943).

Nowell Series (NOW)

The Nowell series is characterized by a Gleyed Black solum, imperfect soil drainage, and materials of non to weakly calcareous fine loamy variable lacustrine and morainal deposits that are derived dominantly from Cretaceous shales. These deposits are usually shallow and are underlain by shale bedrock at depths commonly within 2 m. They occur in association with other Black soils in the Manitou Plain and in transitional areas to the Pembina Hills, mainly in the mid to lower slopes of very gently sloping, undulating landscapes; runoff is moderately slow. Permeability is moderate to moderately slow and may be restricted in areas where the bedrock may be nearer the surface. Most of these soils are under cultivation.

The solum has a very dark gray to black Ap and Ah horizon 20 to 30 cm thick; a dark gray to grayish brown Bm horizon 15 to 20 cm thick with distinct mottles; and a transitional BC horizon 10 to 15 cm thick. The C horizon is weakly mottled and variable in carbonate content; depth to carbonates vary from 60 cm to greater than 100 cm.

The Nowell soils occur in association with the Fifere and Manitou soils of which only a small area was mapped in the D60 project. The Nowell soils were previously mapped as the intermediately drained Blackearth associates of the Manitou Association in the South-Central (1943) report.

Oakley Series (OAY)

The Oakley series consists of moderately well to well drained Orthic Dark Gray soil developed on a mantle (25 to 90 cm) of moderately to very strongly calcareous, shallow loamy (CL,SiCL), till of shale, limestone and granitic origin over weakly to noncalcareous, weathered, Odanah, siliceous, shale bedrock. These soils occur in crest and upper positions of moderate to strong slopes on inclined, undulating and hummocky landscapes; surface runoff is moderate to rapid. Permeability is moderate; water table is below 2 m during the growing season. Oakley soils are often severely water eroded, slightly stony, and non-saline. They have a medium available water holding capacity, low organic matter content, and low natural fertility. Native vegetation includes aspen, oak, ash and mixed grasses. The majority of these soils are currently used for natural grazing

The solum is approximately 40 cm thick with a dark gray Ah horizon, 15 to 20 cm thick; a Bm or Btj horizon, 20 to 30 cm thick. The C horizon is calcareous. Oakley soils were previously mapped as minor inclusions of the Pembina Association in the South-Central (1943) soil report.

Osborne Series (OBO)

The Osborne series consists of poorly drained Rego Humic Gleysol soils developed on moderately to strongly calcareous, clayey sediments. In the study area, some of the Osborne soils include parent materials of clayey fluvial (alluvial) deposition. Drainage is poor and runoff is negligible to very slow because of the depressional topography. Permeability is very slow. The native vegetation consists of meadow grasses, sedge, reeds cattails and some willow. Most of these areas are cultivated and have had improvement of surface drainage.

The solum is characterized by a thin partially decomposed organic layer 5 to 15 cm thick; a very dark

gray to dark gray Ah horizon 10 to 18 cm thick. The C horizon is dark gray to olive gray and calcareous. A thin AC horizon may be present below the Ah; it is a light gray colour indicating that the soil has been affected by prolonged saturation and reducing condition. Distinct to prominent mottles may be present in the C horizon.

In the agricultural portions of the area, the Osborne soils have had some improvement in drainage. In a few areas where no drainage has been undertaken, Osborne peaty phase were mapped. These soils have a 15 to 40 cm thick layer of mesic to humic peat surface.

Osterwick Series (OWK)

The Osterwick series is a Rego Humic Gleysol soil developed on poorly drained, moderately to strongly calcareous, coarse loamy (VFS, LVFS, FSL, VFSL, L), lacustrine and fluvial sediments. These soils occur on depressional topography in association with Reinland and Kronstal soils. Surface runoff is very slow. Permeability is moderately rapid, but is restricted by a seasonal high water table. Some improved surface drainage has occurred, but many areas have not been adequately drained and surface ponding is common. Some forage crops are grown but most areas remain as pasture or native wetlands.

The solum has a thin, moderately decomposed organic Om horizon, 6 to 12 cm thick; a very dark gray Ah horizon, 15 to 25 cm thick and a light gray transitional AC horizon, 5 to 20 cm thick. The Ck horizon is gray with yellowish brown mottles. A lime carbonate accumulation layer (Cca horizon), 20 to 25 cm thick, is commonly found below the AC horizon.

Osterwick soils have severe limitations for agriculture due to excess water in the soil profile for much of the growing season. These soils were mapped as the poorly drained members of the Altona Association in the South-Central (1943) soil report.

Pembina Series (PBI)

The Pembina series consists of moderately well to well drained Dark Gray Luvisol soil developed on moderately to very strongly calcareous, deep, uniform, loamy, mixed till deposits. These soils occur in middle to upper positions of moderate to strong slopes on hummocky landscape; surface runoff is rapid. Permeability is moderate; water table is below 2 m during the growing season. Pembina soils have been affected by water and wind erosion in some areas, they are moderately to severely eroded in upper slope positions. They have high available water holding capacity, moderate organic matter content and moderate natural fertility. Native vegetation includes aspen poplar, oak, Manitoba Maple and other deciduous woods. Most of the areas have been cleared; present land use is for forage and cereal crop production.

The solum is approximately 50 cm thick with a dark grayish brown Ah or Ap horizon, 15 to 20 cm thick; a light gray Ae horizon, 5 to 8 cm thick with platy structure; and a brown to pale brown, clay loam to silty clay textured Bt horizon 15 to 30 cm thick. A white Cca horizon of lime accumulaion may be present below the solum.

Pembina soils occur in close association with Dezwood, Vandal and Firdale soils. Pembina soils were previously mapped as the well drained, dominant associate of the Pembina as-

sociation in the reconnaissance soil survey of South-Central Manitoba (1943).

Perillo Series (PER)

The Perillo series consists of very poorly drained Terric Mesisol soil developed on a mantle (40 to 160 cm) of moderately decomposed organic, material composed of fen peat over moderately to strongly calcareous, deep, uniform, coarse loamy (L, SiL, VFSL), lacustrine deposits. These soils occur in depressional positions on rolling to hummocky landscapes and have very slow to ponded surface runoff. Permeability is very slow; water table is at the surface in the spring and within 1 m during the growing season. Perillo soils are occasionally slightly saline. They have a high available water holding capacity, very high organic matter content, and low natural fertility. Native vegetation often includes sedges, reeds, and clumps of willow or swamp birch. The majority of these soils are currently used for natural grazing.

The solum is approximately 50 cm thick with a black Om horizon, 5 to 15 cm thick; a black Oh horizon, 20 to 45 cm thick; a black Ah horizon, 15 to 25 cm thick, with a few large iron mottles; and a light brownish gray AC horizon 10 to 25 cm thick, with many large prominent iron mottles. The mineral soil parent material is light gray in color with numerous prominent mottles and manganese concretions. Snail shells occur on the surface and throughout the profile.

Perillo soils occur in association with Lelant soils in level to depressional areas of sandy deposits and as the dominant soil in sloughs, shallow lakes and areas of restricted drainage previously mapped as Meadow or Marsh inclusion of many soil associations in the Reconnaissance Soil Survey of South-Central Manitoba (1943).

Pigeon Lake Series (PGK)

The Pigeon Lake series is a Gleyed Cumulic Regosol developed on imperfectly drained, shallow (<1 meter), moderately to strongly calcareous, loamy (SiL, L, SiCL, CL), recent fluvial sediments overlying clayey (SiC, C), lacustrine and fluvial sediments. These soils occur in the western portion of the Red River Plain in proximity to the Assiniboine, Elm, La Salle and Boyne Rivers on level to very gently sloping topography. Pigeon Lake soils are situated in a transition area between deep, loamy, recent fluvial deposits of the La Salle or Gervais soils, and the clayey, lacustrine deposits of the the Red River or Scanterbury soils. Surface runoff is moderately slow to slow. Permeability is moderate to moderately slow in the upper loamy sediments, and slow in the clayey sediments. Inundation and periodic flooding are common during periods of rapid or excess snowmelt. Most of these soils have been cultivated. Tall prairie grasses and deciduous trees occur in small, remnant stands of native vegetation.

The Pigeon Lake soils occur in association with Gervais, Fortier and La Salle soils in transition to the Red River-Osborne soils. They were previously mapped as inclusions within the Riverdale Association of the South-Central (1943) and Winnipeg-Morris (1953) reports.

Plum Coulee Series (PME)

The Plum Coulee series is a Gleyed Black soil developed on imperfectly drained, moderately calcareous, stratified, clayey (SiC, C), fluvial and lacustrine sediments. These soils occur in the western part of the Red River Plain on level to very gently sloping topography. Surface runoff is moderately slow; and permeability is slow. Most of these soils are cleared and under cultivation. Native vegetation consists of tall prairie and prairie-meadow grasses.

The solum has a firm to friable, very dark Ah horizon, 13 to 25 cm thick; a dark gray to dark grayish brown Bmgj horizon, 15 to 30 cm thick with compound weak, medium prismatic and moderate, medium granular structure. Faint mottles are apparent in the lower B horizon and are more noticeable with increasing depth. The mottled Cgj horizon is usually weakly stratified with dominantly clay textures. Gypsum crystals also occur in the C horizon.

Plum Coulee soils occur in association with the Winkler and Deadhorse series. They were previously mapped as imperfectly drained members of the Morden Association and portions of the Gretna Association in the South Central (1943) soil report.

Poplar Point Series (PPR)

The Poplar Point series consists of imperfectly drained Gleyed Cumulic Regosol soil developed on weakly to moderately calcareous, deep, stratified loamy (SiL,L,SiCL,CL), recent fluvial deposits. These soils occur in middle positions of very gentle slopes on flood prone terraces and levees of flood plain landscapes; surface runoff is slow. Permeability is moderate; water table is below 1 m during the growing season. Poplar Point soils are non-eroded, non-stony, and non-saline. They have a medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes deciduous trees and prairie grasses. The majority of these soils are currently cultivated for crop production.

The profile is characterized by a very weak Ah or Ap horizon, 10 to 20 cm thick, and a slightly lighter Ck horizon with distinct iron mottles. Former dark coloured buried Ah layer are common in the substrata.

Poplar Point soils occur in close association with Elm River and Willowbend soils. Poplar Point soils were previously mapped as inclusions of the Assiniboine Complex and Riverdale Association in the Carberry (1957) soil report.

Pouchal Series (POU)

The Pouchal series is characterized by a Humic Luvic Gleysol profile developed under poorly drained conditions on moderately to very strongly calcareous loamy (loam to clay loam) glacial till of shale, limestone and granitic origin. The soils occur in depressional positions of undulating to hummocky landscapes in association with Dark Gray and Luvisolic till soils of Dezwood and Pembina Associations. A variable depth of inwash material is usually present in the surface due to erosion from the upper slopes, particularly in cultivated areas. Runoff is negligeable to ponded. Permeability is moderately slow. These soils are saturated for most of the spring and early summer. Vegetation consists of sedges and ringed with willow. Many areas have been cleared and cultivated at one time, but now are used for hay or pasture.

The solum has a dark gray Ah (Ap) horizon 10 to 15 cm thick; a gray to light gray loam Aeg horizon 5 to 8 cm thick; a clay Btg 25 to 35 cm thick, and a thin transitional BC overlying the till parent material.

Poyser Series (PYR)

The Poyser series consists of well drained Orthic Gray Luvisol soil developed on moderately to strongly calcareous, deep, uniform, fine to coarse loamy (L, CL, SiCL) mixed till deposits. These soils occur in upper slope and crest positions of moderate slopes on hummocky landscapes, generally above 475 m a.s.l. in the Pembina Hills. The slope class may vary from moderately to strongly sloping; surface runoff is rapid. Permeability is moderate; water table is below 2 m during the growing season. Poyser soils are non to moderately eroded, non to moderately stony and non-saline. They have medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation consists of deciduous trees with trembling aspen, oak, Manitoba maple, and an understory of hazel and chokecherry. The majority of these soils are currently used for grain crop and forage production.

The solum is approximately 50 cm thick with a gray Ap or Ah horizon, 10 to 20 cm thick; a light grayish brown Ae horizon, 5 to 10 cm thick with thin platy structure; a dark brown transitional AB horizon, 10 to 15 cm thick; and a dark brown Bt horizon 15 to 20 cm thick with thick clay skins. The parent material is typically yellowish brown calcareous till. Poyser soils were previously mapped as Gray-Wooded associates of the Pembina association in the reconnaissance soil survey of South-Central Manitoba (1943).

Rathwell Series (RWL)

The Rathwell series consists of imperfectly drained Gleyed Black soil developed on strongly calcareous, deep, uniform, fine loamy (CL,SiCL), lacustrine deposits. These soils occur in middle positions of very gentle slopes on level to undulating landscapes; surface runoff is moderate. Permeability is moderately slow; water table is between 1 to 2 m during the growing season. Rathwell soils are non-eroded, non-stony, and may be slightly saline. They have high available water holding capacity, high organic matter content, and high natural fertility. Native vegetation includes prairie grasses, prairie-meadow grasses. The majority of these soils are currently cultivated for grain crop production.

The solum is approximately 50 cm thick with a very dark gray to black Ap or Ah horizon, 20 to 30 cm thick; a brown Bm horizon, 15 to 20 cm thick with distinct mottles; a transitional BC horizon, 8 to 12 cm thick. The Ck horizon has many distinct mottles.

Rathwell soils occur in close association with Eigenhof and Neuhorst soils. Rathwell soils were previously mapped as associates of the Rathwell Association in the Carberry (1957) soil report.

Red River Series (RIV)

The Red River series consists of imperfectly drained Gleyed Rego Black soils developed on moderately to strongly calcareous fine to very fine clayey lacustrine deposits. The topography is level to very gently sloping; runoff is slow. Permeability is slow but may be moderately slow in the lower horizons containing thin varves of silty deposits. Where these silty varves occur, the hori-

zontal permeability is substantially greater than vertical permeability.

They have a high water holding capacity, generally high organic matter content, and high natural fertility. Throughout the project area, the subsoils contain appreciable soluble salts with conductivities of 3 to 4 dS/m.

The solum has a very dark gray Ah horizon 13 to 30 cm thick which tongues into the dark grayish brown (moist) or gray (dry) calcareous AC horizon. The C horizon is a gray to olive gray with fine mottles.

The Red River soils occur in close asscciation with the Scanterbury and Osborne soils. They were mapped as the intermediately drained Blackearth like soil in the Red River Association of the Winnipeg-Morris (1953) report; and as part of the imperfectly to better drained soils of the Myrtle associate in the South-Central (1943) report.

Reinfeld Series (RFD)

The Reinfeld series consists of moderately well to well drained Orthic Black soil developed on moderately to strongly calcareous, stratified, deep, loamy (VFSL,L,SiL), fluvial and lacustrine deposits. These soils occur in upper positions of very gentle slopes on undulating landscapes; surface runoff is moderate. Permeability is moderate; water table is below 2 m during the growing season. Reinfeld soils are non-eroded, non-stony, and non-saline. They have a medium available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation includes tall prairie grasses. The majority of these soils are currently cultivated for grain crop production.

The solum is approximately 50 cm thick with a very dark gray Ah horizon, 15 to 40 cm thick; a brown Bm horizon, 15 to 25 cm thick. The Ck horizon is pale brown with occasional faint mottles.

Reinfeld soils occur in close association with Gnadenthal and Blumenfeld soils. Reinfeld soils were previously mapped as Blackearth associates of the Rathwell Association in the Carberry (1957) soil report; and well drained members of the Altona Association in the South Central (1943) soil report.

Reinland Series (RLD)

The Reinland series consists of imperfectly drained Gleyed Rego Black soil developed on moderately to strongly calcareous, stratified, deep, coarse loamy (LVFS,VFS,FSL,SL), fluvial and lacustrine deposits. These soils occur in middle positions of very gentle slopes on undulating landscapes; surface runoff is moderate. Permeability is moderate to moderately rapid; water table is between 1 to 2 m during the growing season. Reinland soils are non-eroded, non-stony, and usually non-saline. They have a medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes tall prairie grasses. The majority of these soils are currently cultivated for grain crop production.

The solum is approximately 25 cm thick with a very dark gray Ah horizon, 15 to 30 cm thick, with weak calcareousness; and a dark gray to grayish brown AC horizon, 8 to 20 cm thick. A light gray Cca horizon, 8 to 10 cm thick is common below the solum. The Ck horizon is pale brown to light gray with faint mottles.

Reinland soils occur in close association with Hochfeld, Kronstal and Osterwick soils. Reinland soils were previously mapped as associates of the Almasippi Association in the Carberry (1957) soil report; and imperfectly drained members of the Altona Association in the South-Central (1943) soil report.

Rignold Series (RGD)

The Rignold series consists of imperfectly drained Gleyed Black soil developed on a mantle (60 to 90 cm) of moderately calcareous, shallow, uniform, loamy (VFSL,L,SiL,SCL,CL,SiCL), fluvial and lacustrine deposits over moderately calcareous, deep, uniform, clayey (SiC,C), lacustrine deposits. These soils occur in middle positions of nearly level slopes on level landscapes; surface runoff is slow. Permeability is moderate in the loamy strata, and slow to very slow in the clayey substrata. They may have a saturated zone above the clayey strata during the spring or following heavy rains. Rignold soils are non-eroded, non-stony, and non-saline. They have a high available water holding capacity, high organic matter content, and high natural fertility. Native vegetation includes tall prairie grasses, meadow grasses and shrubs. The majority of these soils are currently cultivated for grain crop production.

The solum is approximately 50 cm thick with a very dark gray Ah horizon, 18 to 25 cm thick; a light brown Bm horizon, 20 to 30 cm thick a transitional BC horizon, 10 to 15 cm thick with faint mottles. The Ck horizon is light olive brown with fine yellowish brown mottles.

Rignold soils occur in close association with Denham, Graysville and Edkins soils. Rignold soils were previously mapped as Black Meadow associates of the Rathwell Association in the Carberry (1957) soil report; or as imperfectly drained members of the Altona heavy subsoil phase in the South Central (1943) soil report.

Rosebank Series (RBK)

The Rosebank series is a carbonated, Gleyed Rego Black soil developed on imperfectly drained, moderately calcareous, thin (25 to 100 cm), coarse loamy (LVFS, VFS, FSL), sediments overlying moderately calcareous, clayey (SiC, C), lacustrine sediments. The coarse loamy sediments are usually stratified and include strata of coarser or finer textures. These soils occur on level to very gently sloping topography in association with Hibsin and Elm Creek soils. Surface runoff is slow. Permeability is moderate in the coarse loamy sediments and slow to very slow in the underlying clayey sediments. They may have a saturated zone above the clayey strate during the spring or following heavy rains. They are suceptible to wind erosion, non-stony, and may be weakly saline in some areas. They have a moderate available water holding capacity, moderate organic matter and moderate natural fertility.

The solum has a very dark gray to black, very friable, weakly granular Ah horizon, 15 to 30 cm thick that is often weakly calcareous and mildly alkaline in reaction; a dark gray to grayish brown AC horizon that is granular, very friable to loose, calcareous and mildly alkaline. The Ck horizon is pale brown, very friable to loose, mildly alkaline and faintly mottled. Calcium carbonate concretions and many, fine to medium mottles often occur at the contact with the clayey IICk horizon.

The Rosebank soils occur in association with the Hibsin and Elm Creek soils. They were previously mapped as the imperfectly drained Black-Meadow member of the Almasippi, clay substrate phase in the Carberry (1957) report.

Roseisle Series (RSI)

Roseisle series are well drained, Orthic Black soils that have developed on thin medium grading to moderately fine textured deltaic and lacustrine sediments overlying stony, moderately to strongly calcareous, loamy to clayey water-worked glacial till. Shale bedrock may occur below the till at 1-1.5 meters. Depth of the lacustrine mantle over the till is variable ranging from 25 cm to 1 m in thickness; a thin (<10 cm) gravelly or cobbly lense usually occurs at this contact. Texture of the surface sediments are variable, ranging from fine sandy loam to clay loam. Topography is smooth, gently sloping, eastward in a series of wave-washed terraces formed during the recession of glacial Lake Agassiz; surface runoff is moderate. Permeability is moderately rapid in the surface overlay in the underlying compacted till.

The solum consists of a very dark gray, to black, granular Ah horizon that is friable and neutral in reaction; and a dark grayish brown, granular Bm horizon, friable, and neutral to mildly alkaline in reaction. The B horizon often extends to the gravelly or stony contact of the underlying glacial till.

The Roseisle soils occur in association with the Nanton and Glencross soils. They were previously included as the Blackearth associate of the Blumenstein Complex of the South-Central (1943) report.

Rosengart Series (RSG)

The Rosengart series consists of moderately well drained Orthic Black soil developed on a thin mantle (70 to 95 cm) of moderately to strongly calcareous, uniform, loamy (VFSL,L,SiL), deposits over moderately calcareous, stratified, deep, sandy (LFS,FS,VFS,LVFS), lacustrine deposits. These soils occur in upper positions of very gentle slopes on undulating landscapes; surface runoff is moderate to moderately rapid. Permeability is moderate to moderately rapid; water table is below 2 m during the growing season. Rosengart soils are non-eroded, non-stony, and non-saline. They have medium available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation includes tall prairie grasses. The majority of these soils are currently cultivated for crop production.

The solum is approximately 45 cm thick with a very dark gray Ah horizon, 15 to 35 cm thick; a dark grayish brown Bm horizon, 15 to 25 cm thick; and a BC horizon, 10 to 18 cm thick. The Ck horizon is a pale brown with faint to distinct mottles.

Rosengart soils occur in close association with Jasset and Neuenberg soils. Rosengart soils were previously mapped as Blackearth associates of the Almasippi Association in the Carberry (1957) soil report; and well drained member of the Altona Association in the South-Central (1943) soil report.

Scanterbury Series (SCY)

The Scanterbury series consists of imperfectly to moderately well drained Gleyed Black soils developed on moderately to strongly calcareous clayey montmorillonitic lacustrine deposits. The topography is very

gently sloping; runoff is moderate to moderately slow. They have a high available water holding capacity, generally high organic matter content, and high natural fertility. Throughout the project area, the subsoils may contain appreciable soluble salt with electrical conductivity of 3 to 4 dS/m . Permeability is slow. The native vegetation consisted of tall prairie grasses and herbs.

The solum has a very dark gray, granular clay Ah horizon 15 to 28 cm thick; and a very dark gray to dark grayish brown medium prismatic grading to medium granular to fine subangular blocky Bm horizon 12 to 40 cm thick; fine faint mottles are usually present in the BC and C horizons.

Scanterbury soils occur in close association with Red River and Osborne soils. Scanterbury soils were included with the Red River Association in the South-Central (1943) and Winnipeg, Morris (1953) soil reports.

Skelding Series (SKL)

The Skelding series consists of excessively drained Orthic Regosol soil developed on weakly calcareous, deep, uniform, sandy (FS,LFS), recent eolian deposits. These soils occur in upper positions of gentle slopes on duned landscapes; surface runoff is slow. Permeability is rapid to very rapid; water table is below 2 m during the growing season. The surface of the Skelding soils, if undisturbed, is stabilized if protected by native vegetation cover. They have a low available water holding capacity, low organic matter content, and low natural fertility. Native vegetation includes aspen, juniper, oak and short prairie grasses. The majority of these soils are used for native grazing, improved pasture, or forage production.

The profile is characterized by a dark yellowish brown Ah horizon, 5 to 10 cm thick, and a dark yellowish brown C horizon. A typical profile extends to more than a meter before carbonates occur.

Skelding soils occur in close association with Long Plain, Almasippi and Lelant soils. Skelding soils were previously mapped as inclusions (duned) of the Almasippi Association in the Carberry (1957) soil report.

Squirrel Creek Series (SQR)

The Squirrel Creek series consists of imperfectly drained Gleyed Rego Black soil developed on a mantle (60 to 90 cm) of strongly to very strongly calcareous, shallow, loamy (FSL,L,SiL,SCL), lacustrine deposits over moderately calcareous, uniform, deep, clayey (SiC,C), lacustrine deposits. These soils occur in middle positions of gentle to very gentle slopes on undulating landscapes; surface runoff is slow. Permeability is moderate to moderately slow in the sandy to loamy overlay and slow to very slow in the clayey substrata. The water table is within a meter during the spring and during the growing season. Squirrel Creek soils are non-eroded, non-stony, and usually non-saline. They have a medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes aspen, willow, poplar and prairie grasses. The majority of these soils are currently cultivated for grain crop production.

The profile is characterized by a dark gray Ah horizon, 13 to 20 cm thick, with strong calcareousness; an AC or Cca horizon, 13 to 25 cm thick with strongly to extreme calcareousness; and a moderately calcareous IICk horizon, with prominent iron mottles. Thin strata of weakly cal-

careous fine sands is common above the clay substrate.

Squirrel Creek soils occur in close association with Elm Creek, Rosebank and Layland soils. Above the clay substrata, they are similar to St. Claude soils by having a prominent Cca horizon and imperfect drainage. Squirrel Creek soils were previously mapped as inclusions of the Almasippi, clay substrate in the South-Central (1943) and Carberry (1957) soil reports.

St. Claude Series (SUE)

The St. Claude series consists of imperfectly drained Gleyed Rego Black soil developed on a mantle (50 to 75 cm) of strongly to very strongly calcareous, shallow, loamy (SCL,L,SiL), lacustrine deposits over moderately calcareous, uniform, shallow, sandy (FS,LFS), lacustrine deposits. The upper loamy strata are considered pedogenic and have high content of silt and clay-sized secondary carbonates; generally the amount of clay mineral present is low. These soils occur in middle to lower positions of very gentle to gentle slopes on undulating landscapes; surface runoff is slow. Permeability is moderately slow in the loamy surface strata and rapid in the sandy substrata; water table is between 1 to 1.5 m during the growing season. St. Claude soils are non-eroded, non-stony, and usually non-saline. They have a medium available water holding capacity, medium organic matter content, and low natural fertility. They also have a low bearing capacity and trafficability when saturated. Native vegetation includes aspen, black poplar, willow and prairie grasses. The majority of these soils are currently cultivated for crop production.

The profile is characterized by a dark gray, strongly calcareous Ah horizon, 13 to 20 cm thick; a strongly to extremely calcareous Cca or AC horizon, 13 to 25 cm thick with prominent mottles; and a light yellowish brown to olive gray, moderately calcareous C horizon with many prominent mottles. The parent material is usually finer textured at the 1.5 to 5 m depth.

St. Claude soils occur in close association with Almasippi and Lelant soils. St. Claude soils were previously mapped as inclusions of the Almasippi Association in the South-Central (1943) and Carberry (1957) soil reports.

Stallar Series (SXG)

The Stallar series consists of a well drained Orthic Regosol, lithic phase soil profile developed on a variable mantle (0 to 50 cm) of weakly calcareous loam to clay loam textured materials derived from fragmental, weathered shale, overlying shale bedrock. These soils have moderate to rapid surface runoff. Permeability is moderate in the surface materials and slow to very slow in the underlying shale bedrock. They occur in upper slope and knoll positions in areas of the Pembina Hills where the shale bedrock is close to the surface. The thin profile usually makes this soil droughty in periods of low precipitation.

These soils are characterized by little or no profile development having taken place on the relatively unaltered shaly material over bedrock that lies within half a meter of the surface. The profile is typified by a weak Ah horizon less than 10 cm thick and a C horizon of uniform color. Stallar soils occur in association with the Pembina soils. They

were previously mapped as shale bedrock in the South-Central (1943) soil report.

Stockton Series (SCK)

The Stockton series is an Orthic Black soil developed on moderately well to well drained, weakly to moderately calcareous, sandy (FS, LFS, LS), lacustrine sediments. These soils occur in the Upper Assiniboine Delta, the Brandon Lakes Plain and a few areas within the Lower Assiniboine Delta on very gently sloping to irregular undulating topography in association with Cactus, Lavenham, Hummerston and Sewell soils. Surface runoff is moderate, and permeability is rapid. Wind erosion is common if the soil is not protected with adequate surface or trash cover.

The solum has a very dark gray to very dark grayish brown Ah, 18 to 25 cm thick; a brown to grayish brown Bm horizon, 12 to 22 cm thick; a pale brown to light yellowish brown BC horizon, 8 to 12 cm thick. The Ck horizon is very pale brown with a few yellowish brown mottles below 0.7 m depth. A Cca horizon is usually present.

The Stockton soils were mapped as the well drained member of the Stockton Association in the Carberry (1957) soil report.

Tellier Series (TLI)

The Tellier series consists of imperfectly drained Gleyed Dark Gray soil developed on a mantle (25 to 100 cm) of moderately to strongly calcareous, uniform, fine loamy (L, CL, SICL), lacustrine deposits over moderately to strongly calcareous, deep, uniform fine loamy (CL, L, SICL) mixed till deposits. These soils occur in lower slope positions of very gentle slopes on undulating landscapes and have moderate surface runoff. Permeability is moderate; water table is between 1 to 2 m during the growing season. Tellier soils have high available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation often includes tall prairie and meadow grasses. The majority of these soils are currently used for grain crop production.

The solum is approximately 45 cm thick with a dark gray Ap or Ah horizon, 10 to 20 cm thick; a very dark brown Bt or Btj horizon, 20 to 30 cm thick with a few fine faint iron mottles; and a grayish brown, carbonated, transitional IIBC horizon, 10 to 15 cm thick. The IICk horizon is dark yellowish brown with common, distinct, fine iron mottles.

Tellier soils occur in close association with Altamont and Narish soils. Tellier soils were previously mapped as imperfectly drained associates of the Altamont association in the reconnaissance soil survey of South-Central Manitoba (1943).

Tredwell Series (TDW)

The Tredwell series is characterized by of a Rego Humic Gleysol solum developed in the flood plain of the incised channels commonly mapped as Eroded Slopes Complex. The soil materials are derived from colluvial and fluvial process along the channel and vary in composition depending on the adjacent upland material and underlying bedrock. Only a few areas have been designated at this scale of mapping.

Trinton Series (TNT)

The Trinton series consists of well drained Orthic Dark Gray Luvisol soil developed on a mantle (25 to 100 cm) of moderately to strongly calcareous, stratified, coarse loamy (L, SIL, VFSL), lacustrine deposits over moderately to strongly calcareous, deep, stratified sandy-skeletal (GrS, GrLS), glaciofluvial deposits. These soils occur in upper slope positions of very gentle slopes on hummocky landscapes; surface runoff is moderate. Permeability is moderate; water table is below 2 m during the growing season. Trinton soils have medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes tall prairie grasses interspersed with aspen-oak groves. The majority of these soils are currently used for grain crop production.

The solum is approximately 50 cm thick with a dark gray Ap or Ah horizon, 15 to 20 cm thick; a light gray Ae or Ahe horizon, 5 to 15 cm thick with thin platy structure; a dark brown Bt horizon 10 to 20 cm thick; a dark brown transitional IIBC, 5 to 10 cm thick. The IICk horizon is light brown, thin layers of SiL,L and VFSL may occur in the gravelly deposits.

Trinton soils occur in close association with Vandal, Vartel and Carvey soils. Trinton soils were previously mapped as an associate of the Leary association and as minor inclusions in the Pembina association, in the reconnaissance soil survey of South-Central Manitoba (1943).

Ullrich Series (ULH)

The Ullrich series consists of imperfectly drained Gleyed Black soil developed on a mantle (25 to 100 cm) of moderately to a strongly calcareous, uniform, fine loamy (L,CL,SiCL), lacustrine deposits over moderately to strongly calcareous, deep, uniform, fine loamy (L,CL), mixed till deposits. These soils occur in middle to lower slope positions of very gently sloping to undulating landscapes; surface runoff is moderately slow. Permeability is moderate; water table is between 1 to 2 m during the growing season. Ullrich soils have medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes tall prairie grasses interspersed by aspen-oak groves. The majority of these soils are currently used for grain crop production.

The solum is approximately 35 cm thick with a black to very dark gray Ap or Ah horizon, 10 to 20 cm thick; a very dark brown Bm horizon, 10 to 20 cm thick with fine, faint iron mottles; and a transitional dark brown IIBC horizon, 5 to 10 cm thick. The IICk horizon is grayish brown with common distinct, iron mottles.

Ullrich soils occur in close association with Knudson, Joyale and Guerra soils. Ullrich soils were previously mapped as imperfectly drained associates of the Altamont association in the reconnaissance soil survey of South-Central Manitoba (1943).

Vandal Series (VDL)

The Vandal series consists of well drained Orthic Dark Gray soil developed on a mantle (30 to 100 cm) of moderately to strongly calcareous, thin stratified, coarse-loamy (SiL, L, SL), lacustrine deposits over moderately to strongly calcareous, deep, stratified, sandy skeletal (GrS, LGrS) glaciofluvial deposits. These soils occur in middle and upper positions of very gentle to moderate slopes on hummocky landscapes; surface runoff is moderate. Permeability is moderate in the loamy upper strata and rapid in the sandy skeletal material; water table is below 2 m during the growing season. Vandal soils have low available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes tall prairie grasses aspen popular and scrub oak. The majority of these soils are currently used for mixed farming; where gravel deposits are sufficiently deep, they have been mined as a source for gravel.

The solum is approximately 45 cm thick with a very dark grayish brown Ap or Ah horizon, 10 to 18 cm thick; a grayish brown Bt or Btj horizon, 20 to 35 cm thick. The IICca horizon is yellowish brown, 10 to 20 cm thick, with numerous coarse fragments. The IICk horizon is brown to light brown with mixed shale, limestone and granite gravel which is typically stratified with very gravelly and coarse sand layers (8 to 10 cm); thin (<2 cm) lenses of silt loam to very fine sandy loam may occur at depth amongst the stratified coarser material.

Vandal soils occur in close association with Firdale, Vartel and Carvey soils. Vandal soils were previously mapped as a dominant associate of the Indian Springs complex in the reconnaissance soil survey of South-Central Manitoba (1943).

Vartel Series (VTL)

The Vartel series consists of imperfectly drained Gleyed Dark Gray soil developed on a mantle (25 to 100 cm) of moderately to strongly calcareous, stratified, loamy (SIL, L, SL), lacustrine deposits over moderately to strongly calcareous, stratified, deep sandy-skeletal (GrS, LGrS), glaciofluvial deposits. These soils occur in lower slope positions of very gentle to moderate slopes on hummocky landscapes; surface runoff is moderately slow. Permeability is moderate in the loamy sediments and rapid in coarser substrata; water table is between 1 to 2 m during the growing season. Vartel soils are non-eroded, non-stony and usually non-saline. They have medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes tall prairie grasses and aspen-oak groves. The majority of these soils are currently used for grain crop production.

The solum is approximately 50 cm thick with a dark gray Ap or Ah horizon, 10 to 20 cm thick; a brown to olive brown Bt or Btj horizon, 15 to 30 cm thick with many, fine, faint iron mottles; and an olive brown IIBC horizon, 5 to 15 cm thick with faint iron mottles. The IICk horizon is dark yellowish brown with large, distinct iron mottles. The parent material is a mixed gravel of limestone, granite and shale origin. A typical profile also contains thin strata of L, VFSL and SiL interspersed with gravelly layers.

Vartel soils occur in close association with Vandal and Carvey soils. Vartel soils were previously mapped as imperfectly drained associates of the Leary association and Indian Springs complex in the reconnaissance soil survey of South-Central Manitoba (1943).

Watrine Series (WTI)

The Watrine series is characterized by a Humic Luvic Gleysol solum, poor soil drainage and materials of thin veneers (up to 90 cm) of moderately to strongly calcareous fine loamy (L-CL) lacustrine or fluvial lacustrine sediments overlying moderately to strongly calcareous glacial till of shale, limestone and granitic origin. The soils occur in depressional position of undulating landscapes in association with the Dark Gray and Luvisolic Altamont and Kingsley Association. Some inwash material is usually present in the surface due to erosion from upper slopes, particularly in cultivated areas. Runoff is negligeable to ponded except when the surface drainage has been improved. Permeability is moderately slow. Native vegetation consists of sedge, reeds, with willow clumps.

The solum has a dark gray loam Ah or Ahe horizon 8 to 12 cm thick; a gray to light gray loam Aeg horizon 5 to 8 cm thick; and a clay loam to clay Btg horizon 25 to 35 cm thick; and a variable transitional BC horizon commonly extending to the till contact within a meter. The inwash material above the Ah is variable, but commonly less then 15 cm.

The Watrine soils were previously mapped as the poorly drained inclusions of the Altamont Association in the South-Central (1943) soil report.

Willowbend Series (WWB)

The Willowbend series consists of poorly drained Rego Humic Gleysol soil developed on moderately to strongly calcareous, stratified, deep, loamy (FSL,SL,L,SiL,CL,SiCL), recent alluvial deposits. Strata can very in texture of FS to CL depending on source area and landscape position relative to stream channels. These soils occur in level to depressional positions of very gentle slopes on floodplain landscapes; surface runoff is very slow to ponded. Permeability is moderately slow; water table is within 1 m during the growing season. Willowbend soils are non-eroded, non-stony, and usually non-saline. They have a medium available water holding capacity, medium organic matter content, and low natural fertility. Native vegetation includes sedges, rushes, reeds and willows. The majority of these soils are currently in native vegetation.

The profile is characterized by a moderately decomposed Oh horizon, 5 to 10 cm thick; a very dark gray Ah horizon, 15 to 20 cm thick with moderate calcareousness; and a light brownish gray to very pale brown Ck horizon with many prominent mottles. Buried Ah horizons often occur throughout the soil profile.

Willowbend soils occur in close association with La Salle and Gervais soils. Willowbend soils were previously mapped as inclusions of the Assiniboine Complex and Riverdale associates in the Carberry (1957) report; and the Riverdale Association in the Winnipeg-Morris (1953) report.

Willowcrest Series (WWC)

The Willowcrest series consists of imperfectly drained Gleyed Black soil developed on weakly to moderately calcareous, deep, uniform, sandy (LFS,FS), lacustrine deposits. Finer textured deposits underlie the sands at depths of 1.5 to 3.5 meters. These soils occur in middle positions of gentle slopes on undulating landscapes; surface runoff is moderate. Permeability is moderately rapid to rapid; water table is between 1 to 2 m during the growing season. Willow-

crest soils are occasionally slightly eroded and are non-stony and non-saline. They have a low available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes tall prairie grasses. The majority of these soils are currently cultivated for forage or grain crops.

The solum is approximately 55 cm thick with a very dark gray to very dark brown Ah horizon, 18 to 25 cm thick; and a dark brown to yellowish brown Bm horizon, 25 to 40 cm thick with distinct iron mottles. A Cca horizon, 13 to 20 cm thick is usually present. The Ck horizon is pale brown with many prominent mottles.

Willowcrest soils occur in close association with Skelding, Long Plain and Lelant soils. Willowcrest soils were previously mapped as Black Meadow associates of the Almasippi Association in the Carberry (1957) soil report. In the South-Central (1943) soil report, they were the imperfectly to moderately well drained members of the Almasippi Association.

Winkler Series (WIK)

The Winkler series consists of moderately well drained Orthic Black soil developed on moderately calcareous, deep, stratified, clayey (SiC,C), lacustrine deposits. These soils occur in middle positions of very gentle slopes on undulating landscapes; surface runoff is moderately slow. Permeability is moderately slow; water table is generally between 1.5 to 2 m during the growing season. Winkler soils are non-eroded, non-stony, and non-saline. They have a high available water holding capacity, high organic matter content, and high natural fertility. Native vegetation includes tall prairie grasses, shrubs and aspen-oak groves. The majority of these soils are currently cultivated for grain crop production.

The solum is approximately 45 cm thick with a very dark gray Ah horizon, 13 to 25 cm thick; a dark brown Bm horizon, 20 to 35 cm thick with moderate medium granular to prismatic structure. The Ck horizon is dominantly SiC to C in texture and may be stratified with lighter textures at depth.

Winkler soils occur in close association with Dead Horse and Plum Coulee soils. Winkler soils were previously mapped as Blackearth associates of the Rathwell Association in the Carberry (1957) soil report; and moderately well drained member of the Morden Association of the South-Central (1943) soil report.

Winkler, heavy clay varient (WIK2)

The Winkler, heavy clay variant is characterized by an Orthic Black solum, on moderately well to well drained soil materials of fine to very fine clayey fluvial and lacustrine sediments. They occur in association with the Gretna soils and may have Solonetzic Black properties in some areas. These soils are found in the lower slopes of the Escarpment and western parts of the Red River Plain. Topography is very gently sloping; runoff is moderate. Permeability is slow to very slow. The subsoils may have some gypsum crystals and other soluble salts.

The Winkler, heavy clay variant differs from the Winkler series because of the increased clay content throughout the profile. The Winkler variant has a clay content ranging from 55 to 85 percent while the normal Winkler series have clay contents commonly between 40 to 50 percent with some strata of silty textures in the subsoil.

Worden Series (WOR)

The Worden series is characterized by an Orthic Regosol soil, excessive to good soil drainage, and materials of deep (>100 cm) moderately to strongly calcareous clay loam textured glacial till of shale, limestone and granitic origin. These soils occur on the knoll positions of moderate to very strongly sloping landscapes and are subject to wind and water erosion; surface runoff is moderate to rapid. Permeability is moderate to moderately slow. These soils are the eroded members in association with the well drained Darlingford and Hebbot series.

The solum is very shallow and limited to a thin Ap horizon (less than 10 cm). In some areas the Ap layer may have incorporated part of the C horizon. Productivity of these soils is limited and conservation practices are required for improvement.

Xavier Series (XVI)

The Xavier series consists of very poorly drained Typic Mesisol soil developed on deep (>160 cm), moderately decomposed, mesic fen peat deposits. These soils occur in depressional positions on level landscapes; surface runoff is very slow to ponded. Permeability is moderately slow; water table is at or near the surface during the growing season. They have a high available water holding capacity, high organic matter content, and medium natural fertility. Native vegetation includes sedges, rushes, reeds and willow. The majority of these soils are currently in native vegetation.

Xavier soil is characterized by a dark yellowish brown Of horizon, 10 to 30 cm thick, which is medium acid to neutral; and a thick, very dark brown, medium acid to neutral Om horizon; grading into a black, weakly acid to weakly calcareous Oh horizon. Underlying mineral strata range in texture from loam to clay at depths below 160 cm.

Yustak Series (YTK)

The Yustak series is characterized by a Rego Humic Gleysol solum, poor soil drainage, and materials with a thin veneer of moderately to strongly calcareous coarse loamy (LVFS,VFS,FSL) sediments overlying moderately to strongly calcareous stratified sand and gravel deposits. These soils occur in level to depressional positions of undulating or hummocky morainic-like landscapes that were influenced by glacial fluvial processes and subsequent ponding. Runoff is restricted, but some lateral flow through the coarser material occurs. Permeability is moderate in the upper strate and rapid in the lower strata, but is restricted during periods of saturation and high water table conditions. Vegetation consists of dominantly sedge and reeds; commonly willow occurs on the perifery of the depression as a "willow ring."

The solum is approximately 25 cm thick with a very dark gray Ah horizon that ranges from 15 to 25 cm thick; and moderately calcareous AC horizon 7 to 15 cm thick; a peaty layer (Om) 5 to 15 cm thick is commonly present.

The Yustak soils occur in close association with the Vartel and Vandal soils. They were previously mapped as poorly drained Meadow or Calcareous Meadow inclusions within the Blumenstein Complex, Agassiz and Leary Associations in the South-Central (1943) report.

Zaplin Series (ZPI)

The Zaplin series consists of imperfectly drained Gleyed Dark Gray soil developed on moderately to strongly calcareous, deep, uniform, fine loamy (L, CL, SICL), till deposits of mixed limestone, granite and shale origin. These soils occur in lower slope positions of gentle slopes on hummocky landscapes; surface runoff is moderately slow. Permeability is moderate; water table is between 1 to 2 m during the growing season. Zaplin soils are non-eroded, slightly stony and non-saline. They have a medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes tall prairie and aspen-oak groves. The majority of these soils are currently used for grain crop production.

The solum is approximately 45 cm thick with a dark gray Ap or Ah horizon, 10 to 20 cm thick; a very dark brown Bt or Btj horizon, 20 to 30 cm thick with a few, fine, faint mottles; and a grayish brown transitional BC horizon, 10 to 15 cm thick. The Ck horizon is dark with many fine, distinct mottles.

Zaplin soils occur in close association with Dezwood and Horose soils. Zaplin soils were previously mapped as imperfectly drained minor associates of the Pembina association in the reconnaissance soil survey of South-Central Manitoba (1943).

Zinman Series (ZIM)

The Zinman series is characterized by a Gleyed Solonetzic Dark Gray solum, imperfect soil drainage, and a thin veneer of moderately to strongly calcareous clayey lacustrine sediments over water modified glacial till deposits. They occur within the Manitou Plain at elevations approximately 457 to 465 m a.s.l. and are associated with localized areas of salinity and seepage; they occupy the intermediate to lower slope positions of near level to gently sloping, undulating topography; surface runoff is slow. Permeability is slow to very slow particularly in the B horizon. Gypsum and other soluble salts (magnesium and sodium sulfates) are usually present below the solum.

The solum has a dark gray Ah or Ap horizon 10 to 15 cm thick; a gray Ahe or Ae horizon 5 to 10 cm thick; a black to very dark gray columnar Bn_1 horizon 10 to 18 cm; an amorphous very dark gray Bn_2 horizon that is quite compact and breaks into subangular blocky peds. Some salts and gypsum are usually present in the lower part of the B horizon and in the transitional BC horizon. The depth of lacustrine veneer or water modification (inwash) vary from less than 30 cm to greater than 75 cm; the underlying till is dominantly clay loam in texture, but can vary in composition in terms of shale, granitic and limestone fragments.

The Zinman soils occur in close association with Altamont, Joyale and Guerra soils. The Zinman soils were previously mapped as imperfectly drained alkalinized (Solonetz) members of the Altamont and Snowflake Associations in the South-Central (1943) report.

PART 4

USE AND MANAGEMENT INTERPRETATIONS OF SOILS

4.1 INTRODUCTION

This section provides predictions of performance or soil suitability ratings for various land uses based on field observations of soil and landscape characteristics, laboratory data and on observations of soil behavior under specified conditions of land use and management. Suitability ratings or interpretations are intended only to serve as guides for planners and managers. Caution, with an understanding of the limitations of the soil map, must be exercised when applying suitability ratings to soil map units. The value of any rating or interpretation depends upon the nature and composition of individual map unit delineations, which in turn depends on the scale of mapping and intensity of ground truthing employed in the survey.

In this section, interpretive soil information is provided for the following land use evaluations;

1. Agriculture
   a) dryland farming capability
   b) irrigation suitability
2. Engineering Uses
3. Recreation Uses

4.2 AGRICULTURAL LAND USE EVALUATION

Climatic Conditions for crop growth

Regional climatic conditions in the project area (Table 3) are considered to be the most favorable in Manitoba for growing a wide variety of cereal, pulse and horticultural crops. This section provides an overview of the types of climatic data available or that can readily be computed to evaluate crop performance. More detailed examples and definitions are provided in the reference "Southern Manitoba's Climate and Agriculture" (Dunlop et al. 1984).

Maximum temperatures and precipitation in the study area occur in the growing season (Table 3). In many years however, the combination of heat and moisture available for crop growth are still less than optimum. Although length of growing season varies annually as well as with location in the study area (Table 7), the frost-free period is generally of sufficient duration, to mature most crops in most years. The distribution of precipitation may vary widely throughout the growing season and insufficient precipitation may result in water deficits for wheat of 50 to 100 mm (and reduced crop yields) about 10 percent of the time. A summary of climatic information relevant to crop production in the study area is presented in Table 7 and 8.

Good crop performance is dependent on an adequate time span to mature and sufficient heat units over this interval for optimum growth. Most cereal, pulse, and horticultural crops require approximately 100 days to mature. Other crops require longer growing seasons to mature; i.e. fababeans in excess of 115 days; grain corn 120 days; sunflower 130 days; and sugar beets 140 days. The length of frost-free period therefore serves as a guide for growing sensitive crops such as corn, potatoes, buckwheat, cucumbers and tomatoes which are affected by temperature at or just below 0C. The probability of occurrence of various frost-free periods is important for a proper evaluation of the risk of growing a particular crop to maturity. A general guide to dates of freezing temperature and associated frost-free period at various probabilities as 1 year in 10, 1 year in 4, etc. is presented in Table 7.

The length of growing season for hardy agricultural crops such as cereals, flax, sunflower, sugar beet, peas and lentils is determined by the occurrence of a killing frost of -2.2°C. Such crops are able to benefit from a considerably longer growing season as indicated in Table 9.

Thermal characteristis of the growing season as measured by Growing Degree Days (GDD's) and Corn Heat Units (CHU's) are utilized to evaluate the agricultural potential of an area (Table 8). For plant growth, degree-days accumulated for a base temperature of 5C express the length and warmth of the growing season in a single figure. These heat unit figures serve as an index of the amount of energy available to plants for growth. The variation in growing degree-days accumulated throughout the study area is shown in Table 8. For the Morden to Portage area east of the Manitoba Escarpment, the average growing degree-days during the May 1 to September 30 period exceeds 1650; at the 10% risk level, the number of GDD is near 1500. Growing degree-days accumulated to the west above the Manitoba Escarpment tend to be somewhat less.

Corn heat units provide yet another evaluation of the thermal attributes of a region in relation to the growth of corn. The average CHU's in the Morden to Portage area is approximately 2500, generally sufficient for grain corn production.

Table 7. Frost Data, and Probability Values for Last Freezing Temperature in Spring and First Freezing Temperature in Fall at Morden and Portage la Prairie, Manitoba (Environment Canada 1982).

Probability of:	Location	Probability Level, % (years)						
		10% (1 in 10)	25% (1 in 4)	33% (1 in 3)	50% (1 in 2)	66% (2 in 3)	75% (3 in 4)	90% (9 in 10)
Spring frost on or after	Morden	June 1	May 26	May 21	May 17	May 14	May 12	May 8
	Portage	May 31	May 23	May 21	May 15	May 11	May 11	May 6
Fall frost on or before	Morden (CDA)	Sept. 11	Sept. 19	Sept. 21	Sept. 23	Sept. 24	Sept. 28	Oct. 4
	Portage	Sept. 10	Sept. 13	Sept. 19	Sept. 24	Oct. 3	Oct. 8	Oct. 15
Frost-free period (days) equal to or less than	Cypress River	99	105	107	114	124	125	133
	Deerwood	106	117	122	125	128	136	149
	Graysville	92	106	112	119	124	128	134
	Morden (CDA)	106	119	124	125	133	134	137
	Pilot Mound	103	108	109	120	124	125	138
	Portage	104	118	125	134	136	142	157

Table 8. Climatic parameters relevant to crop growth at selected climatic stations in South-Central Manitoba (Dunlop, 1981).

Parameters	Probability Level	Morden CDA	Portage Airport	Graysville	Roland	Deerwood	Pilot Mound	Cypress River
Corn Heat Units	50	2627	2517	2434	2501	2525	2323	2397
	25	2481	2367	2302	2352	2344	2183	2259
	10	2349	2228	2183	2215	2175	2056	2134
Growing Degree Days (base 5°C)	50	1758	1647	1616	1657	1661	1531	1619
	25	1663	1571	1557	1582	1579	1451	1528
	10	1577	1502	1477	1513	1502	1378	1446
Frost Free Period -2.2°C (days)	50	147	148	139	143	141	140	136
	25	134	135	129	131	130	128	125
	10	122	123	120	121	120	116	115
Water Deficit mm Soft dough stage Wheat	50	-22	+	-32	-23	-11	+	-24
	25	-55	-27	-65	-52	-24	-33	-58
	10	-85	-56	-96	-78	-56	-65	-88

+ = adequate moisture

Because CHU accumulation is expected to be less than 2300 in approximately 1 year out of 10 (10% risk level), successful long term grain corn production is dependent on selection of hybrids that will mature in the local area in relation to the risk of receiving less than optimum CHU's. The lower CHU accumulation encountered in some years should be sufficient for corn silage production. Slightly lower Corn Heat Unit accumulations are received on the area to the west and above the Manitoba Escarpment.

Yearly variation in rainfall is of great importance to agriculture in the study area. In the Morden to Portage area, based on records from 1885 to the present, growing season precipitation has ranged from less than 150 mm to more than 450 mm.

Most of the soils on the study area experience varying degrees of soil water deficit for varying periods of time. Soil water deficits calculated for selected location in the study area vary greatly depending on properties and characteristics of the soil and the period in the growing season for which the calculation is made. The soil moisture deficits are calculated for loamy textured soils with available water holding capacity of about 100 mm at time of seeding. Precipitation during the growing season is added to the available water and evapotranspiration is subtracted. As the growing season progresses, precipitation and available soil moisture are used for plant growth until eventually moisture uptake by the crop causes the soil water status to take on negative values. The deficits shown in Table 8 are generally applicable for clayey soils, but will be higher on sandy soils with a lower soil water capacity. Therefore, crops grown on sandy soils are considered to be more prone to drought unless additional moisture is available from a near-surface water table. Soils with a high water table will have lower soil water deficits as long as the water table is within 1 to 1.5 m of the soil surface during the growing season.

4.3 SOIL CAPABILITY FOR AGRICULTURE

Dryland Agriculture

Soil capability classification for dryland agriculture is based on evaluation of both internal and external soil characteristics that influence soil suitability and limitations for agricultural use. In this classification, mineral soils are grouped into capability classes, subclasses and units based on their limitations for dryland farming, risk of damage when the soils are used and the way they respond to management (ARDA, 1965). There are seven capability classes, each of which groups soils together that have the same relative degree of limitation or hazard for agricultural use. The limitation becomes progressively greater from Class 1 to Class 7. The Class indicates the general suitability of the soils for agriculture. The first three classes are considered capable of sustained production of common field crops, the fourth is marginal for sustained arable culture, the fifth is suitable only for improved permanent pasture, the sixth is capable of use only for native pasture while the seventh class is for soils and land types considered incapable of use for arable agriculture or permanent pasture.

Definition of the Capability Classes

Class 1 Soils in this class have no important limitations for crop use. The soils have level or gently sloping topography; they are deep, well to imperfectly drained and have moderate water holding capacity. The soils are naturally well supplied with plant nutrients, easily maintained in good tilth and fertility; soils are moderately high to high in productivity for a wide range of cereal and special crops.

Class 2 Soils in this class have moderate limitations that reduce the choice of crops or require moderate conservation practices. The soils have good water holding capacity and are either naturally well supplied with plant nutrients or are highly responsive to inputs of fertilizer. They are moderate to high in productivity for a fairly wide range of crops. The limitations are not severe and good soil management and cropping practices can be applied without serious difficulty.

Class 3 Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices. The limitations in Class 3 are more severe than those in Class 2 and conservation practices are more difficult to apply and maintain. The limitations affect the timing and ease of tillage, planting and harvesting, the choice of crops and maintenance of conservation practices. The limitations include one or more of the following: moderate climatic limitation, erosion, structure or permeability, low fertility, topography, overflow, wetness, low water holding capacity or slowness in release of water to plants, stoniness and depth of soil to consolidated bedrock. Under good management these soils are fair to moderately high in productivity for a fairly wide range of field crops.

Class 4 Soils in this class have severe limitations that restrict the choice of crops or require special conservation practices or both. These soils have such limitations that they are only suited for a few crops, or the yield for a range of crops may be low, or the risk of crop failure is high. The limitations may seriously affect such farm practices as the timing and ease of tillage, planting and harvesting, and the application and maintenance of conservation practices. These soils are low to medium in productivity for a narrow range of crops but may have higher productivity for a specially adapted crop. The limitations include the adverse effects of one or more of the following: climate, accumulative undesirable soil characteristics, low fertility, deficiences in the storage capacity or release of soil moisture to plants, structure or permeability, sa-

linity, erosion, topography, over- flow, wetness, stoniness, and depth of soil to consolidated bedrock.

Class 5 Soils in this class have very severe limitations that restrict their capability to producing perennial forage crops, and improvement practices are feasible. These soils have such serious soil, climatic or other limitations that they are not capable of use for sustained production of annual field crops. However, they may be improved by the use of farm machinery for the production of native or tame species of perennial forage plants. Feasible improvement practices include clearing of bush, cultivation, seeding, fertilizing and water control.

Some soils in Class 5 can be used for cultivated field crops provided unusually intensive management is used. Some of these soils are also adapted to special crops requiring soil conditions unlike those needed by the common crops.

Class 6 Soils in this class are capable only of producing perennial forage crops and improvement practices are not feasible. Class 6 soils have some natural sustained grazing capacity for farm animals, but have such serious soil, climatic or other limitations as to make impractical the application of improvement practices that can be carried out on Class 5 soils. Soils may be placed in this class because their physical nature prevents the use of farm machinery, or because the soils are not responsive to improvement practices, or because stock watering facilities are inadequate.

Class 7 Soils in this class have no capability for arable culture or permanent pasture because of extremely severe limitations. Bodies of water too small to delineate on the map are included in this class. These soils may or may not have a high capability for forestry, wildlife and recreation.

Organic soils within the map area are rated for "potential" agricultural capability after the method of Leeson (Leeson, et al., 1969). Capability ratings of organic soils for agriculture must recognize that most organic soils have little or no value for agriculture in their native state and their potential is only achieved through reclamation or development implemented with varying degrees of difficulty. Capability class definitions for organic soils are the same as for mineral soils. They are however, identified on maps and tables with the prefix "O".

Soil Capability subclasses are divisions within classes which group soils with similar kinds of limitations and hazards for agricultural use. The various kinds of limitations recognized at the subclass level are defined in Table 9.

A summary of the soils showing their major characteristics and their interpretive classification for dry-land agriculture is presented in Table 10.

TABLE 9 Agricultural Capability Subclass Limitations

C - Adverse climate: This subclass denotes a significant adverse climate for crop production as compared to the "median" climate which is defined as one with sufficiently high growing season temperatures to bring field crops to maturity, and with sufficient precipitation to permit crops to be grown each year on the same land without a serious risk of partial or total crop failures.

D - Undesirable soil structure and/or low permeability: This subclass is used for soils difficult to till, or which absorb water very slowly or in which the depth of rooting zone is restricted by conditions other than a high water table or consolidated bedrock.

E - Erosion: Subclass E includes soils where damage from erosion is a limitation to agricultural use. Damage is assessed on the loss of productivity and on the difficulties in farming land with gullies.

F - Low fertility: This subclass is made up of soils having low fertility that either is correctable with careful management in the use of fertilizers and soil amendments or is difficult to correct in a feasible way. The limitation may be due to lack of available plant nutrients, high acidity or alkalinity, low exchange capacity, high levels of carbonates or presence of toxic compounds.

I - Inundation by streams or lakes: This subclass includes soils subjected to inundation causing crop damage or restricting agricultural use.

L - Coarse wood fragments: In the rating of organic soils, woody inclusions in the form of trunks, stumps and branches (>10 cm diameter) in sufficient quantity to significantly hinder tillage, planting and harvesting operations.

M - Moisture limitation: This subclass consists of soils where crops are adversely affected by droughtiness owing to inherent soil characteristics. They are usually soils with low water-holding capacity.

N - Salinity: Designates soils which are adversely affected by the presence of soluble salts.

P - Stoniness: This subclass is made up of soils sufficiently stony to significantly hinder tillage, planting, and harvesting operations. Stony soils are usually less productive than comparable non-stony soils.

R - Consolidated bedrock: This subclass includes soils where the presence of bedrock near the surface restricts their agricultural use. Consolidated bedrock at depths greater than 1 meter from the surface is not considered as a limitation, except on irrigated lands where a greater depth of soil is desirable.

T - Topography: This subclass is made up of soils where topography is a limitation. Both the percent of slope and the pattern or frequency of slopes in different directions are important factors in increasing the cost of farming over that of smooth land, in decreasing the uniformity of growth and maturity of crops, and in increasing the hazard of water erosion.

W - Excess water: Subclass W is made up of soils where excess water other than that brought about by inundation is a limitation to their use for agriculture. Excess water may result from inadequate soil drainage, a high water table, seepage or runoff from surrounding areas.

X - Cumulative minor adverse characteristics: This subclass is made up of soils having a moderate limitation caused by the cumulative effect of two or more adverse characteristics which singly are not serious enough to affect the class rating.

Table 10 Agricultural Capability Class for Soils and Areas within each of the Municipalities in the Project Area.

MAP SYMBOL AND PHASE	SOIL NAME	AGRICULTURAL CAPABILITY CLASS	IRRIGATION SUITABILITY	TOTAL HECTARES	PERCENT	DUFFERIN	GREY	ROLAND	STANLEY	THOMPSON
ARNxcxx	Aronet	4ME	4S	40	.01	0	40	0	0	0
ARNxxxx	Aronet	4ME	4S	5	.00	4	0	0	0	1
ASSxcxx	Almasippi	3MT	3SD	128	.03	110	0	6	0	12
ASSxxxs	Almasippi	3NM	3SD	5	.00	5	0	0	0	0
ASSxxxx	Almasippi	2M	2SD	19,328	5.94	8,667	10,410	0	0	251
ASSxxxx1	Almasippi	3M	3SD	622	.19	0	622	0	0	0
ASS0cxx	Almasippi	3ME	3SD	8	.00	0	8	0	0	0
ASS0xxx	Almasippi	3ME	3SD	762	.23	415	347	0	0	0
ASS1cxx	Almasippi	3ME	3SD	5	.00	5	0	0	0	0
ASS1xxx	Almasippi	3ME	3SD	635	.19	504	131	0	0	0
ASS2xxx	Almasippi	3EM	3SD	9	.00	0	9	0	0	0
ASZxcxx	Agassiz	5M	4S	459	.14	0	0	0	12	447
ASZxc1x	Agassiz	5M	4S	50	.01	0	0	0	50	0
ASZxc3x	Agassiz	5M	4S	119	.03	0	0	0	119	0
ASZxdxx	Agassiz	5M	4S	15	.00	0	0	0	0	15
ASZxd1x	Agassiz	5M	4ST	27	.00	0	0	0	0	27
ASZxxxx	Agassiz	5M	4S	1,238	.38	0	0	0	1,136	102
ASZ0cxx	Agassiz	5M	4S	20	.00	0	0	0	0	20
ASZ1x1x	Agassiz	5M	4S	101	.03	0	0	0	0	101
ASZ2cxx	Agassiz	5ME	4S	3	.00	0	0	0	0	3
ATNxcxx	Altamont	2T	3S	153	.04	0	0	0	123	30
ATNxdxx	Altamont	3T	3ST	28	.00	0	0	0	28	0
ATNxxxx	Altamont	1	3S	2,342	.72	0	0	0	1,611	731
ATNxx1x	Altamont	1	3S	110	.03	0	0	0	110	0
ATN1c1x	Altamont	1	3S	125	.03	0	0	0	125	0
BEOxc1x	Benton	4RD	4S	18	.00	0	0	0	18	0
BEOxc2x	Benton	4RD	4S	23	.00	0	0	0	23	0
BEOxc4x	Benton	5P	4S	94	.02	0	0	0	94	0
BEOxdxx	Benton	4RD	4ST	38	.01	0	0	0	0	38
BEOxd3x	Benton	4RD	4ST	69	.02	0	0	0	69	0
BEOxd4x	Benton	5P	4ST	92	.02	0	0	0	29	63
BEOxexx	Benton	5TR	4ST	164	.05	0	0	0	122	42
BEOxe2x	Benton	5TR	4ST	52	.01	0	0	0	52	0
BEOxxxx	Benton	4RD	4S	409	.12	0	0	0	383	26
BEO1d1x	Benton	4RD	4ST	46	.01	0	0	0	0	46
BIPxxxs	Bishop	3RN	4S	56	.01	0	0	0	56	0
BIPxxxx	Bishop	3R	4S	86	.02	0	0	0	0	86
BKAxcxx	Birkenhead	5M	4S	932	.28	0	0	0	626	306
BKAxc1x	Birkenhead	5M	4S	9	.00	0	0	0	9	0
BKAxc2x	Birkenhead	4M	4S	18	.00	0	0	0	18	0
BKAxdxx	Birkenhead	5M	4ST	124	.03	0	0	0	23	101
BKAxexx	Birkenhead	5MT	4ST	86	.02	0	0	0	86	0
BKAxxxx	Birkenhead	5M	4S	375	.11	23	0	106	148	98
BKRxxxx	Basker	6WI	4D	118	.03	0	0	0	118	0
BMGxxxs	Blumengart	3DW	4S	629	.19	0	0	71	104	454
BMGxxxt	Blumengart	4N	4S	892	.27	0	0	0	133	759
BMGxxxu	Blumengart	5N	4S	429	.13	0	0	0	0	429
BMGxxxx	Blumengart	3DW	4S	2,869	.88	0	0	64	1,227	1,578
BNFxxxs	Blumenfeld	5W	4DS	229	.07	2	0	0	28	199
BNFxxxsd	Blumenfeld	4WN	4DS	14	.00	0	14	0	0	0
BNFxxxt	Blumenfeld	5WN	4DS	251	.07	0	0	0	0	251
BNFxxxu	Blumenfeld	6NW	4DS	105	.03	0	0	0	0	105
BNFxxxx	Blumenfeld	5W	4D	490	.15	253	164	0	0	73
BNFxxxxd	Blumenfeld	3W	4DS	86	.02	73	13	0	0	0
BNFxxxxp	Blumenfeld	6W	4SD	71	.02	0	65	0	0	6

Table 10.

AGRICULTURAL CAPABILITY CLASSES

MAP SYMBOL AND PHASE	SOIL NAME	AGRICULTURAL CAPABILITY CLASS	IRRIGATION SUITABILITY	TOTAL HECTARES	PERCENT	DUFFERIN	GREY	ROLAND	STANLEY	THOMPSON
BNFxxxxpd	Blumenfeld	4W	4DS	9	.00	0	9	0	0	0
BNF0xxx	Blumenfeld	5W	4D	36	.01	36	0	0	0	0
BNIxcxx	Brundis	4R	4S	27	.00	0	0	0	27	0
BNIxxxx	Brundis	3R	4S	115	.03	0	0	0	107	8
BOXxxxx	Boxner	6W	4D	56	.01	0	0	0	0	56
BUMxxxs	Blumenort	5W	4D	592	.18	0	0	0	167	425
BUMxxxt	Blumenort	5WN	4D	420	.12	0	0	0	66	354
BUMxxxx	Blumenort	5W	4DS	588	.18	0	0	0	0	588
BUMxxxxp	Blumenort	6W	4D	204	.06	0	14	0	0	190
Carman				201	.06	201	0	0	0	0
CAVxxxx	Carvey	5W	4D	526	.16	0	0	0	526	0
CAVxxxxp	Carvey	6W	4D	90	.02	0	0	0	90	0
CAVxx2x	Carvey	5W	4D	22	.00	0	0	0	22	0
CAVxx3x	Carvey	5W	4D	19	.00	0	0	0	19	0
CTZxcxx	Chortitz	3I	3D	235	.07	60	0	2	0	173
CTZxdxx	Chortitz	4IT	4TS	26	.00	0	0	0	0	26
CTZxxxs	Chortitz	3IN	3DS	443	.13	1	0	225	10	207
CTZxxxx	Chortitz	3I	3D	1,747	.53	597	65	58	197	830
CXTxxxx	Capell	2M	2SD	508	.15	0	0	0	508	0
CXTxx1x	Capell	2M	3SD	82	.02	0	0	0	82	0
CXTxx2x	Capell	2M	3SD	103	.03	0	0	0	103	0
CYNxcxx	Croyon	3M	2ST	20	.00	0	0	0	20	0
CYNxc2x	Croyon	3M	2S	81	.02	0	0	0	81	0
CYNxxxx	Croyon	3M	2S	512	.15	0	0	0	512	0
CYN1x1x	Croyon	3M	2ST	21	.00	0	0	0	21	0
CZKxxxx	Cazlake	6W	4DS	141	.04	0	0	0	47	94
Ditch				399	.12	185	0	214	0	0
DGFxcxx	Darlingford	2T	3S	151	.04	0	0	0	48	103
DGFxc1x	Darlingford	2T	3S	192	.05	0	0	0	161	31
DGFxc2x	Darlingford	2T	3S	21	.00	0	0	0	21	0
DGFxfxx	Darlingford	5T	4TS	23	.00	0	0	0	0	23
DGFxxxx	Darlingford	2X	3S	1,676	.51	0	0	0	1,625	51
DGFxx1x	Darlingford	2X	3S	462	.14	0	0	0	329	133
DGFxx2x	Darlingford	2X	3S	19	.00	0	0	0	19	0
DGF1cxx	Darlingford	2T	3S	28	.00	0	0	0	28	0
DGF1c1x	Darlingford	2T	3S	277	.08	0	0	0	277	0
DGF1xxx	Darlingford	2X	3S	130	.03	0	0	0	130	0
DGF1x1x	Darlingford	2X	3S	236	.07	0	0	0	236	0
DGF2c1x	Darlingford	3TE	3S	129	.03	0	0	0	129	0
DGF2f3x	Darlingford	6TE	4ST	22	.00	0	0	0	22	0
DGSxxxs	Dugas	3NW	4S	139	.04	0	0	0	0	139
DGSxxxt	Dugas	4N	4S	8	.00	0	0	0	0	8
DGSxxxx	Dugas	2W	4S	583	.17	23	30	167	0	363
DHOxxxs	Deadhorse	3NW	4SD	254	.07	45	0	0	106	103
DHOxxxx	Deadhorse	2W	4SD	4,465	1.37	3,573	0	36	282	574
DHOxxxx1	Deadhorse	2W	4SD	1,546	.47	1,546	0	0	0	0
DNHxcxx	Denham	2T	3S	19	.00	0	0	19	0	0
DNHxxxx	Denham	1	3S	5,615	1.72	734	9	4,509	0	363
DNH0xxx	Denham	2X	3S	27	.00	0	0	27	0	0
DOTxxxx	Dorset	5M	4S	21	.00	0	0	0	21	0
DXMxc2x	Druxman	2M	2SD	54	.01	0	0	0	54	0
DXMxxxx	Druxman	2M	2SD	526	.16	0	0	0	526	0
DXTxxxx	Dexter	4M	4S	120	.03	0	0	0	5	115
DZWxcxx	Dezwood	2T	3S	3,189	.98	0	0	0	2,525	664
DZWxc1x	Dezwood	2T	3S	3,247	.99	0	0	0	720	2,527

Table 10.

AGRICULTURAL CAPABILITY CLASSES

MAP SYMBOL AND PHASE	SOIL NAME	AGRICULTURAL CAPABILITY CLASS	IRRIGATION SUITABILITY	TOTAL HECTARES	PERCENT	DUFFERIN	GREY	ROLAND	STANLEY	THOMPSON
DZWxc2x	Dezwood	2T	3S	259	.07	0	0	0	259	0
DZWxdxx	Dezwood	3T	3ST	739	.22	0	0	0	730	9
DZWxd1x	Dezwood	3T	3TS	641	.19	0	0	0	138	503
DZWxd2x	Dezwood	3T	3TS	76	.02	0	0	0	76	0
DZWxexx	Dezwood	4T	4T	65	.01	0	0	0	65	0
DZWxxxx	Dezwood	2X	3S	1,072	.32	0	0	0	650	422
DZWxx1x	Dezwood	2X	3S	255	.07	0	0	0	140	115
DZW1cxx	Dezwood	2T	3S	507	.15	0	0	0	243	264
DZW1c1x	Dezwood	2T	3S	488	.15	20	0	0	36	432
DZW1dxx	Dezwood	3T	3TS	591	.18	0	0	0	218	373
DZW1d1x	Dezwood	3T	3TS	520	.15	0	0	0	520	0
DZW1d2x	Dezwood	3T	3TS	162	.04	0	0	0	152	10
DZW1exx	Dezwood	4T	4T	31	.00	0	0	0	31	0
DZW1e2x	Dezwood	4T	4T	83	.02	0	0	0	0	83
DZW2c2x	Dezwood	3TE	3TS	46	.01	0	0	0	46	0
EBGxxxx	Edenburg	1	1	370	.11	164	0	92	20	94
EDKxxxs	Edkins	5W	4DS	26	.00	0	16	10	0	0
EDKxxxx	Edkins	5W	4DS	154	.04	23	83	48	0	0
EDKxxxxd	Edkins	3W	4DS	56	.01	7	35	14	0	0
EDKxxxxp	Edkins	6W	4DS	48	.01	0	48	0	0	0
EDKxxxxpd	Edkins	4W	4DS	8	.00	0	8	0	0	0
EEKxxxx	Elm Creek	2M	3SD	1,708	.52	949	549	181	0	29
EGFxxxx	Eigenhof	1	1	745	.22	251	0	293	0	201
ERXxxxx	Eroded Slope Complex	6T	4T	7,832	2.40	0	0	0	4,967	2,865
Fannystel				54	.01	0	54	0	0	0
FFRxdxx	Fifere	3T	3T	97	.02	0	0	0	97	0
FRSxxxs	Ferris	3NW	3DS	12	.00	0	0	0	12	0
FRSxxxx	Ferris	2W	3D	109	.03	0	0	0	57	52
FRSxx2x	Ferris	2W	3DS	89	.02	0	0	0	41	48
FTExxxs	Fortier	3NW	4DS	349	.10	0	0	349	0	0
FTExxxx	Fortier	2W	4DS	510	.15	495	0	15	0	0
FTNxxxx	Fortina	5W	4D	15	.00	0	0	0	0	15
FWKxc3x	Froswick	4P	4S	12	.00	0	0	0	0	12
FWKxdxx	Froswick	3RT	4ST	6	.00	0	0	0	0	6
FWKxe2x	Froswick	4TR	4ST	7	.00	0	0	0	7	0
FWKxxxs	Froswick	3RN	4S	18	.00	0	0	0	0	18
FWKxxxx	Froswick	3R	4S	178	.05	0	0	0	50	128
FWKxx1x	Froswick	3R	4S	53	.01	0	0	0	53	0
FWKxx4x	Froswick	5P	4S	65	.01	0	0	0	65	0
FWK1c2x	Froswick	3R	4S	3	.00	0	0	0	3	0
Gravelpit				7	.00	0	0	0	6	1
GCSxcxs	Glencross	3NW	4SD	91	.02	0	0	0	91	0
GCSxcxx1	Glencross	3R	4SD	60	.01	0	0	0	0	60
GCSxc1s	Glencross	3NW	4SD	96	.02	0	0	0	96	0
GCSxc1x	Glencross	2W	4SD	112	.03	0	0	0	112	0
GCSxc2x	Glencross	2W	4SD	10	.00	0	0	0	0	10
GCSxxxs	Glencross	3NW	4SD	154	.04	0	0	0	72	82
GCSxxxt	Glencross	4N	4S	799	.24	0	0	0	485	314
GCSxxxx	Glencross	2W	3D	460	.14	0	0	0	214	246
GCSxx1s	Glencross	3NW	4SD	53	.01	0	0	0	53	0
GCSxx2s	Glencross	3NW	4SD	198	.06	0	0	0	198	0
GCSxx4x	Glencross	5P	4S	23	.00	0	0	0	23	0
GCSxx5s	Glencross	6P	4S	240	.07	0	0	0	240	0
GDHxcxx	Gnadenthal	2T	2D	71	.02	0	71	0	0	0
GDHxxxs	Gnadenthal	3NW	3SD	335	.10	0	0	39	73	223

Table 10.

AGRICULTURAL CAPABILITY CLASSES

MAP SYMBOL AND PHASE	SOIL NAME	AGRICULTURAL CAPABILITY CLASS	IRRIGATION SUITABILITY	TOTAL HECTARES	PERCENT	DUFFERIN	GREY	ROLAND	STANLEY	THOMPSON
GDHxxxt	Gnadenthal	4N	4SD	127	.03	0	0	0	115	12
GDHxxxx	Gnadenthal	1	2D	4,116	1.26	731	182	333	0	2,870
GRAxxxs	Gretna	3DN	4S	2,439	.75	0	0	0	841	1,598
GRAxxxt	Gretna	4ND	4S	177	.05	0	0	0	0	177
GRAxxxu	Gretna	5N	4S	12	.00	0	0	0	0	12
GRAxxxx	Gretna	3D	4D	3,480	1.07	0	0	0	0	12
GRRxxxs	Guerra	5W	4D	318	.09	0	0	0	10	3,369
GRRxxxsd	Guerra	4WN	4Ds	29	.00	0	0	101	278	40
GRRxxxt	Guerra	5WN	4D	32	.00	0	0	0	29	0
GRRxxxx	Guerra	5W	4D	1,383	.42	0	0	0	32	0
GRRxxxxp	Guerra	6W	4D	256	.07	0	0	0	980	403
GRRxx1s	Guerra	5W	4DS	40	.01	0	0	0	46	210
GRRxx2t	Guerra	5WN	4D	23	.00	0	0	0	40	0
GRRxx2x	Guerra	6WP	4DS	17	.00	0	0	0	23	0
GRRxx3t	Guerra	6WP	2DT	63	.01	0	0	0	17	0
GRRxx4t	Guerra	2W	3DS	69	.02	0	0	0	63	0
GVSxcxx	Gervais	2W	2DT	203	.06	203	0	0	69	0
GVSxxxx	Gervais	2W	4SD	1,217	.37	1,099	0	0	0	0
GVS1cxx	Gervais	3NW	3SD	7	.00	7	0	148	0	118
GYVxxxs	Graysville	2W		265	.08	36	321	2,093	0	0
GYVxxxx	Graysville		3S	6,061	1.86	3,217	22	0	199	81
Haywood		2X	3ST	22	.00	0	0	0	23	0
HEBxxxx	Hebbot	3T	3S	199	.06	0	0	0	66	430
HEB1d1x	Hebbot	3TE	3S	23	.00	0	0	42	0	0
HEB2c1x	Hochfeld	3M	2S	66	.02	0	0	196	46	335
HHFxcxx	Hochfeld	3M	2S	80	.02	0	0	32	0	18
HHFxxxx	Hochfeld	3ME	2S	1,053	.32	476	0	0	0	0
HHF0xxx	Hochfeld	4ME	3SD	63	.01	13	0	0	0	0
HHF2xxx	Hibsin	2M	3SD	17	.00	17	0	0	0	7
HINxcxx	Hibsin	2M	4S	25	.00	25	0	182	0	0
HINxxxx	Horndean	3NW	4S	281	.08	92	0	62	0	72
HNDxxxs	Horndean	4N	4S	62	.01	0	0	0	0	1,241
HNDxxxt	Horndean	2W	4D	72	.02	0	0	22	0	109
HNDxxxx	Horose	6W	4SD	1,291	.39	28	0	0	0	0
HOSxxxx	Jirose	3RN	4SD	109	.03	0	0	0	46	7
JISxxxs	Jirose	3R	3S	46	.01	0	0	0	0	17
JISxxxx	Jordan	2T	3S	7	.00	0	0	0	0	21
JODxcxx	Jordan	1	2D	17	.00	0	0	56	0	353
JODxxxx	Jasset	1	3SD	141	.04	57	7	572	10	0
JSTxxxx	Joyale	3NW	3SD	1,009	.31	70	4	0	168	0
JYLxxxs	Joyale	4N	3D	168	.05	0	0	0	34	15
JYLxxxt	Joyale	2W	4ST	34	.01	0	0	0	448	0
JYLxxxx	Klidal	5TR	4S	463	.14	0	0	0	43	0
KDAxcxx	Klidal	4RD	4S	43	.01	0	0	0	34	0
KDAxxxs	Klidal	4RD	4S	34	.01	0	0	0	138	56
KDAxxxx	Klidal	4RD	3S	138	.04	0	0	0	0	75
KDAxx1s	Kingsley	2X	2SD	56	.01	0	0	0	0	0
KISxxxx	Kronstal	2M	3SD	75	.02	26	0	0	0	0
KOTxcxx	Kronstal	3NW	2SD	26	.00	53	0	0	0	300
KOTxxxs	Kronstal	2M	2SD	53	.01	0	454	37	0	0
KOTxxxx	Kronstal	2T	2SD	3,994	1.22	3,203	0	0	0	0
KOT0cxx	Kronstal	2M	3SD	788	.24	788	0	0	0	0
KOT0xxx	Kronstal	6W	4D	234	.07	234	0	0	0	0
KOT1xxx	Kronstal			74	.02	44	30	0	19	
KRNxx3s	Kerran			19	.00	0	0			

Table 10.

AGRICULTURAL CAPABILITY CLASSES

MAP SYMBOL AND PHASE	SOIL NAME	AGRICULTURAL CAPABILITY CLASS	IRRIGATION SUITABILITY	TOTAL HECTARES	PERCENT	DUFFERIN	GREY	ROLAND	STANLEY	THOMPSON
KUDxcxx	Knudson	2T	3S	32	.00	0	0	0	32	0
KUDxxxx	Knudson	1	3S	727	.22	0	0	0	689	38
KUDxx1x	Knudson	2X	3S	26	.00	0	0	0	26	0
KUD1c1x	Knudson	2T	3S	272	.08	0	0	0	272	0
KUD1Dxx	Knudson	2T	3S	18	.00	0	0	0	0	18
Lagoon				6	.00	6	0	0	0	0
LAYxxxx	Layland	5W	4D	27	.00	8	19	0	0	0
LAYxxxxd	Layland	3W	4D	32	.00	5	27	0	0	0
LAYxxxxp	Layland	6W	4D	93	.02	10	83	0	0	0
LAYxxxxpd	Layland	4W	4D	15	.00	0	15	0	0	0
LEIxxxx	Levine	3I	3D	118	.03	0	0	0	118	0
LEWxcxx	Loewen	6WI	4D	38	.01	0	0	0	0	38
LEWxxxsp	Loewen	6WI	4D	345	.10	0	0	0	0	345
LEWxxxx	Loewen	6WI	4D	137	.04	42	0	72	0	23
LEWxxxxp	Loewen	6WI	4D	236	.07	218	0	0	0	18
LLTxxxs	Lelant	5W	4D	23	.00	0	0	0	0	23
LLTxxxsp	Lelant	6W	4D	192	.05	12	0	0	0	180
LLTxxxspd	Lelant	4W	4D	8	.00	0	8	0	0	0
LLTxxxx	Lelant	5W	4D	3,600	1.10	1,455	2,074	0	0	71
LLTxxxxd	Lelant	3W	4D	857	.26	459	398	0	0	0
LLTxxxxp	Lelant	6W	4D	2,558	.78	236	2,310	0	0	12
LLTxxxxpd	Lelant	4W	4D	774	.23	0	774	0	0	0
LLT0xxx	Lelant	5W	4D	41	.01	41	0	0	0	0
LOPxcxx	Long Plain	3M	3SD	2,111	.64	753	1,358	0	0	0
LOPxcxx1	Long Plain	4M	3SD	460	.14	0	460	0	0	0
LOPxdxx	Long Plain	4MT	3TS	55	.01	0	55	0	0	0
LOPxxxx	Long Plain	3M	3SD	14,708	4.52	4,863	9,767	0	0	78
LOPxxxx1	Long Plain	4M	3SD	1,446	.44	0	1,446	0	0	0
LOP0cxx	Long Plain	3ME	3SD	945	.29	209	736	0	0	0
LOP0xxx	Long Plain	3ME	3SD	1,640	.50	1,020	620	0	0	0
LOP0xxx1	Long Plain	4ME	3SD	6	.00	0	6	0	0	0
LOP1cxx	Long Plain	3ME	3SD	600	.18	196	404	0	0	0
LOP1cxx1	Long Plain	4ME	3SD	609	.18	0	609	0	0	0
LOP1xxx	Long Plain	3ME	3SD	933	.28	694	239	0	0	0
LOP1xxx1	Long Plain	4ME	3SD	491	.15	0	491	0	0	0
LOP2cxx	Long Plain	4EM	3SD	61	.01	61	0	0	0	0
LOP2xxx	Long Plain	4ME	3SD	128	.03	104	24	0	0	0
LRYxcxx	Leary	5M	4S	5	.00	0	0	0	0	5
LRYxc1x	Leary	5M	4S	2	.00	2	0	0	0	0
LRYxc2x	Leary	5M	4S	81	.02	0	0	0	0	81
LRYxdxx	Leary	5M	4ST	85	.02	0	0	0	0	85
LRYxd1x	Leary	5M	4ST	88	.02	0	0	0	0	88
LRYxd2x	Leary	5M	4ST	67	.02	0	0	0	0	67
LRYxxxx	Leary	5M	4S	105	.03	0	0	0	6	99
LRY1cxx	Leary	5M	4S	50	.01	50	0	0	0	0
LRY1c1x	Leary	5M	4ST	3	.00	0	0	0	0	3
LRY1Exx	Leary	5MT	4ST	46	.01	0	0	0	0	46
LSLxcxx	La Salle	2T	2T	33	.01	33	0	0	0	0
LSLxxxx	La Salle	2X	1	820	.25	748	0	0	0	72
MFIxxxx	Mansfield	4M	4S	30	.00	0	0	0	26	4
MHCxxxx	Marsh Complex	7W	4D	9	.00	0	0	0	9	0
MOWxxxx	Mowbray	1	1	24	.00	0	0	0	24	0
MRHxxxx	Marringhurst	5M	4S	13	.00	0	0	0	0	13
MRSxxxx	Morris	2W	4S	292	.08	84	64	144	0	0
MXSxxxx	Manitou	1	3S	111	.03	0	0	0	0	111

Table 10.

AGRICULTURAL CAPABILITY CLASSES

MAP SYMBOL AND PHASE	SOIL NAME	AGRICULTURAL CAPABILITY CLASS	IRRIGATION SUITABILITY	TOTAL HECTARES	PERCENT	DUFFERIN	GREY	ROLAND	STANLEY	THOMPSON
MYTxxxx	Myrtle	1	4S	2,254	.69	3	431	1,820	0	0
MYT0xxx	Myrtle	1	4S	26	.00	0	0	26	0	0
NBGxxxs	Neuenberg	3NW	3SD	592	.18	17	89	74	270	142
NBGxxxt	Neuenberg	4N	3SD	164	.05	0	0	0	122	42
NBGxxxx	Neuenberg	1	2D	6,114	1.88	2,007	940	979	64	2,124
NBG1xxx	Neuenberg	1	2D	12	.00	0	12	0	0	0
NKKxc1x	Nikkel	2W	3D	58	.01	0	0	0	0	58
NKKxxxs	Nikkel	3NW	3D	21	.00	0	0	0	0	21
NKKxxxx	Nikkel	2W	3D	691	.21	0	0	0	147	544
NKKxx1s	Nikkel	3NW	3D	59	.01	0	0	0	0	59
NKKxx1x	Nikkel	2W	3D	12	.00	0	0	0	0	12
NTOxxxx	Nanton	2W	3DS	68	.02	0	0	0	58	10
NTOxx1s	Nanton	3NW	3DS	230	.07	0	0	0	230	0
NTOxx1x	Nanton	2W	3Ds	28	.00	0	0	0	0	28
NTOxx2x	Nanton	2W	3DS	133	.04	0	0	0	133	0
NUHxxxs	Neuhorst	3NW	3SD	272	.08	43	0	0	213	16
NUHxxxx	Neuhorst	1	2D	2,540	.78	2,085	9	345	95	6
NWNxxxs	Newton Siding	3NW	3SD	124	.03	0	0	17	0	107
NWNxxxt	Newton Siding	4N	3SD	46	.01	0	0	0	0	46
NWNxxxx	Newton Siding	1	2D	442	.13	87	0	70	0	285
OAYxcxx	Oakley	3R	4S	490	.15	0	0	0	490	0
OAYxc1x	Oakley	3R	4S	102	.03	0	0	0	0	102
OAYxc4x	Oakley	5P	4S	19	.00	0	0	0	19	0
OAYxdxx	Oakley	4RT	4S	5	.00	0	0	0	5	0
OAYxd1x	Oakley	4RT	4S	110	.03	0	0	0	110	0
OAYxd2x	Oakley	4RT	4S	154	.04	0	0	0	154	0
OAYxxxx	Oakley	3R	4S	254	.07	0	0	0	163	91
OAY1cxx	Oakley	3R	4S	270	.08	0	0	0	0	270
OAY1xxx	Oakley	3R	4S	83	.02	0	0	0	0	83
OAY2g1x	Oakley	6T	4ST	6	.00	6	0	0	0	0
OBOxxxs	Osborne	3WN	4Ds	453	.13	344	0	109	0	0
OBOxxxsd	Osborne	3WN	4DS	3,197	.98	963	27	2,207	0	0
OBOxxxtd	Osborne	4N	4DS	33	.01	0	33	0	0	0
OBOxxxx	Osborne	3W	4D	8,060	2.47	729	6,130	1,110	0	91
OBOxxxxd	Osborne	3W	4DS	32,847	10.10	12,682	13,094	7,050	0	21
OBOxxxxp	Osborne	6W	4D	2	.00	0	1	1	0	0
OBOxxxxpd	Osborne	4W	4DS	6	.00	0	6	0	0	0
OWKxxxx	Osterwick	5W	4D	312	.09	265	33	0	0	14
OWKxxxxd	Osterwick	3W	4D	61	.01	46	15	0	0	0
OWKxxxxp	Osterwick	6W	4D	55	.01	32	23	0	0	0
OWKxxxxpd	Osterwick	4W	4D	7	.00	0	7	0	0	0
PBIxcxx	Pembina	2T	3S	360	.11	0	0	0	67	293
PBIxc1x	Pembina	2T	3S	218	.06	0	0	0	110	108
PBIxdxx	Pembina	3T	3ST	53	.01	0	0	0	53	0
PBIxe1x	Pembina	4T	4T	55	.01	0	0	0	0	55
PBIxxxx	Pembina	2X	3S	355	.10	40	0	0	0	315
PBI1cxx	Pembina	2T	3S	176	.05	0	0	0	0	176
PBI1c1x	Pembina	2T	3S	131	.04	1	0	0	0	130
PBI1c2x	Pembina	2T	3S	23	.00	0	0	0	0	23
PBI1dxx	Pembina	3TE	3ST	61	.01	0	0	0	0	61
PBI1d1x	Pembina	3TE	3ST	321	.09	0	0	0	0	321
PBI1exx	Pembina	4TE	4T	33	.01	0	0	0	0	33
PBI1e1x	Pembina	4TE	4T	121	.03	0	0	0	0	121
PBI1fxx	Pembina	5T	4T	7	.00	0	0	0	0	7
PBI2d1x	Pembina	3TE	4T	108	.03	36	0	0	0	72

Table 10.

AGRICULTURAL CAPABILITY CLASSES

MAP SYMBOL AND PHASE	SOIL NAME	AGRICULTURAL CAPABILITY CLASS	IRRIGATION SUITABILITY	TOTAL HECTARES	PERCENT	DUFFERIN	GREY	ROLAND	STANLEY	THOMPSON
PERxxxx	Perillo	03W	4D	548	.16	33	448	0	0	67
PERxxxxd	Perillo	03W	4DS	7	.00	0	7	0	0	0
PERxxxx1	Perillo	03W	4DS	686	.21	0	0	0	0	686
PGKxxxx	Pigeon Lake	2W	3SD	516	.15	516	0	0	0	0
PMExxxx	Plum Coulee	2W	4S	3,129	.96	729	110	235	223	1,832
PMExxxx1	Plum Coulee	2W	4S	186	.05	179	0	7	0	0
POUxxxx	Pouchal	6W	4DS	80	.02	0	0	0	59	21
PPRxcxx	Poplar Point	3I	2SD	76	.02	76	0	0	0	0
PPRxxxx	Poplar Point	3I	2SD	57	.01	57	0	0	0	0
PYRxxxx	Poyser	2X	3S	35	.01	0	0	0	0	35
Roland				60	.01	0	0	60	0	0
RBKxxxs	Rosebank	3NW	4SD	11	.00	0	11	0	0	0
RBKxxxx	Rosebank	2W	3SD	1,504	.46	676	607	108	0	113
RBKxxxx1	Rosebank	2W	3SD	11	.00	0	11	0	0	0
RFDxcxx	Reinfeld	2T	1	1	.00	0	0	1	0	0
RFDxxxx	Reinfeld	1	1	1,618	.49	502	0	339	0	777
RFD1xxx	Reinfeld	1	1	45	.01	0	0	0	0	45
RGDxxxs	Rignold	3N	3SD	77	.02	0	0	77	0	0
RGDxxxx	Rignold	1	3SD	9,828	3.02	3,956	805	4,666	53	348
RGD0xxx	Rignold	1	3SD	6	.00	0	0	6	0	0
RIVxxxs	Red River	3NW	4SD	181	.05	0	0	181	0	0
RIVxxxx	Red River	2W	4SD	18,604	5.72	2,659	8,843	6,835	0	267
RLDxcxx	Reinland	2M	2ST	41	.01	0	0	41	0	0
RLDxxxs	Reinland	3NW	3SD	24	.00	0	24	0	0	0
RLDxxxx	Reinland	2M	2S	7,052	2.16	4,769	1,208	226	66	783
RLD0xxx	Reinland	2M	2S	198	.06	193	0	0	0	5
RLD1xxx	Reinland	2ME	2S	717	.22	628	14	1	0	74
RSGxcxx	Rosengart	1	1	78	.02	0	0	8	0	70
RSGxxxx	Rosengart	1	1	1,486	.45	210	0	874	0	402
RSG0xxx	Rosengart	1	1	9	.00	0	0	9	0	0
RSG1cxx	Rosengart	2T	1	4	.00	0	0	4	0	0
RSIxcxx	Roseisle	2T	2T	777	.23	0	0	0	250	527
RSIxc1x	Roseisle	2T	2T	320	.09	0	0	0	160	160
RSIxc2x	Roseisle	2T	2S	226	.06	0	0	0	202	24
RSIxc3x	Roseisle	4P	3TS	8	.00	0	0	0	8	0
RSIxc4x	Roseisle	5P	4S	19	.00	0	0	0	19	0
RSIxc5x	Roseisle	6P	4S	51	.01	0	0	0	51	0
RSIxd1x	Roseisle	3T	3T	108	.03	0	0	0	108	0
RSIxexx	Roseisle	4T	4T	13	.00	0	0	0	0	13
RSIxxxx	Roseisle	1	2S	780	.23	0	0	0	69	711
RSIxx1x	Roseisle	2X	1	723	.22	0	0	0	723	0
RSIxx2x	Roseisle	2X	2S	136	.04	0	0	0	136	0
RSIxx3x	Roseisle	4P	4S	178	.05	0	0	0	161	17
RSIxx5x	Roseisle	6P	4S	125	.03	0	0	0	125	0
RSI1e5x	Roseisle	6P	4S	3	.00	0	0	0	3	0
RSI2e3x	Roseisle	5PT	4ST	17	.00	0	0	0	17	0
RWLxxxx	Rathwell	1	2D	238	.07	223	15	0	0	0
St.Claude				71	.02	0	71	0	0	0
SCKxcxx	Stockton	3M	3S	6	.00	6	0	0	0	0
SCKxexx	Stockton	4T	4T	8	.00	8	0	0	0	0
SCKxxxx	Stockton	3M	3S	261	.08	168	0	0	0	93
SCK0cxx	Stockton	3ME	3S	29	.00	29	0	0	0	0
SCK0xxx	Stockton	3ME	3S	9	.00	9	0	0	0	0
SCK1xxx	Stockton	3ME	3S	50	.01	23	0	0	0	27
SCK2cxx	Stockton	4EM	3S	13	.00	13	0	0	0	0

Table 10.

AGRICULTURAL CAPABILITY CLASSES

MAP SYMBOL AND PHASE	SOIL NAME	AGRICULTURAL CAPABILITY CLASS	IRRIGATION SUITABILITY	TOTAL HECTARES	PERCENT	DUFFERIN	GREY	ROLAND	STANLEY	THOMPSON
SCYxxxx	Scanterbury	2W	4SD	24,261	7.46	1,996	11,501	10,365	0	399
SKLxcxx	Skelding	5M	4S	1,029	.31	457	572	0	0	0
SKLxcxx1	Skelding	6M	4S	89	.02	0	89	0	0	0
SKLxdxx	Skelding	5M	4ST	478	.14	246	232	0	0	0
SKLxdxx1	Skelding	6M	4ST	97	.02	0	97	0	0	0
SKLxdxx1a	Skelding	7ME	4ST	6	.00	0	6	0	0	0
SKLxexx	Skelding	5MT	4ST	84	.02	28	56	0	0	0
SKLxexx1	Skelding	6M	4ST	98	.03	0	98	0	0	0
SKLxfxx	Skelding	5MT	4ST	114	.03	48	66	0	0	0
SKLxfxx1	Skelding	6TM	4ST	30	.00	0	30	0	0	0
SKLxgxx	Skelding	6TM	4ST	74	.02	5	69	0	0	0
SKLxgxx1	Skelding	6TM	4ST	91	.02	0	91	0	0	0
SKLxgxx1a	Skelding	7TE	4ST	41	.01	0	41	0	0	0
SKLxxxx	Skelding	5M	4S	132	.04	66	66	0	0	0
SKLxxxx1	Skelding	6M	4S	9	.00	0	9	0	0	0
SKL0cxx	Skelding	5ME	4S	13	.00	1	12	0	0	0
SKL1cxx	Skelding	5ME	4S	7	.00	0	7	0	0	0
SQRxxxs	Squirrel Creek	3NW	4SD	29	.00	16	0	0	0	13
SQRxxxx	Squirrel Creek	2W	4SD	264	.08	77	11	0	0	176
SUExcxx	St.Claude	2W	4SD	27	.00	23	4	0	0	0
SUExxxs	St.Claude	3NW	4SD	353	.10	147	50	0	0	156
SUExxxu	St.Claude	5N	4SD	11	.00	0	0	0	0	11
SUExxxx	St.Claude	2W	4SD	8,840	2.71	4,166	4,338	0	0	336
SUExxxx1	St.Claude	2W	4SD	44	.01	0	44	0	0	0
SUE0xxx	St.Claude	2W	4SD	96	.02	88	8	0	0	0
SUE1xxx	St.Claude	2W	4SD	7	.00	0	7	0	0	0
SXGxc4x	Stallar	5P	4S	36	.01	0	0	0	0	36
SXGxdxx	Stallar	5R	4S	12	.00	0	0	0	12	0
SXGxd1x	Stallar	5R	4ST	14	.00	0	0	0	0	14
SXGxe4x	Stallar	5PT	4ST	22	.00	0	0	0	22	0
SXGxfxx	Stallar	5RT	4ST	6	.00	0	0	0	0	6
SXGxxxx	Stallar	5R	4S	6	.00	0	0	0	0	6
SXG1fxx	Stallar	6T	4ST	66	.02	0	0	0	66	0
TDWxxxx	Tredwell	6W	4D	15	.00	0	0	0	15	0
TLIxcxx	Tellier	2T	3SD	27	.00	0	0	0	27	0
TLIxxxx	Tellier	2W	3D	965	.29	0	0	0	716	249
TNTxxxx	Trinton	3M	3S	74	.02	57	0	0	0	17
ULHxcxx	Ullrich	2T	3D	27	.00	10	0	0	0	17
ULHxc1x	Ullrich	2T	3D	465	.14	0	0	0	465	0
ULHxc2x	Ullrich	2T	3SD	132	.04	0	0	0	132	0
ULHxxxx	Ullrich	2W	3D	1,473	.45	0	0	0	837	636
ULHxx1x	Ullrich	2W	3D	295	.09	0	0	0	248	47
ULH1e2x	Ullrich	2T	3SD	20	.00	0	0	0	20	0
VDLxcxx	Vandal	3M	2S	211	.06	0	0	0	0	211
VDLxc1x	Vandal	3M	2S	35	.01	35	0	0	0	0
VDLxdxx	Vandal	3MT	4ST	120	.03	0	0	0	0	120
VDLxxxx	Vandal	3M	2S	280	.08	0	0	0	0	280
VDLxx1x	Vandal	3M	2S	49	.01	0	0	0	0	49
VDL1cxx	Vandal	3M	2S	127	.03	64	0	0	0	63
VTLxxxx	Vartel	4M	2SD	121	.03	0	0	0	0	121
WIKxcxx	Winkler	2T	3S	22	.00	0	0	0	15	7
WIKxcxx2	Winkler	2D	3S	79	.02	0	0	0	0	79
WIKxdxx1	Winkler	3T	4ST	8	.00	0	0	0	0	8
WIKxdxx2	Winkler	3T	4ST	60	.01	0	0	0	60	0
WIKxexx2	Winkler	4T	4S	15	.00	0	0	0	15	0

Table 10.

AGRICULTURAL CAPABILITY CLASSES

MAP SYMBOL AND PHASE	SOIL NAME	AGRICULTURAL CAPABILITY CLASS	IRRIGATION SUITABILITY	TOTAL HECTARES	PERCENT	DUFFERIN	GREY	ROLAND	STANLEY	THOMPSON
WIKxfxx2	Winkler	5T	4ST	74	.02	0	0	0	74	0
WIKxxxx	Winkler	1	3S	979	.30	338	41	0	269	331
WIKxxxx1	Winkler	1	3S	113	.03	0	0	0	0	113
WIKxxxx2	Winkler	2D	3S	1,270	.39	0	0	18	356	896
WORxc1x	Worden	3E	3S	53	.01	0	0	0	53	0
WORxxxx	Worden	3E	3S	18	.00	0	0	0	18	0
WTIxxxx	Watrine	5W	4D	7	.00	0	0	0	7	0
WWBxxxx	Willowbend	6WI	4SD	670	.20	654	0	6	0	10
WWB1cxx	Willowbend	6WI	4SD	14	.00	14	0	0	0	0
WWCxcxx	Willowcrest	3M	3SD	182	.05	119	63	0	0	0
WWCxxxx	Willowcrest	3M	3SD	10,043	3.08	4,109	5,600	23	0	311
WWCxxxx1	Willowcrest	3M	3SD	19	.00	0	19	0	0	0
WWC0cxx	Willowcrest	3ME	3SD	143	.04	103	40	0	0	0
WWC0xxx	Willowcrest	3ME	3SD	1,143	.35	653	490	0	0	0
WWC1cxx	Willowcrest	3ME	3SD	62	.01	62	0	0	0	0
WWC1xxx	Willowcrest	3ME	3SD	693	.21	532	160	0	0	1
WWC2cxx	Willowcrest	4ME	3SD	95	.02	29	66	0	0	0
WWC2xxx	Willowcrest	4ME	3SD	84	.02	46	38	0	0	0
XVIxxxx	Xavier	03W	4D	15	.00	0	15	0	0	0
YTKxx2t	Yustak	5WN	4DS	36	.01	0	0	0	36	0
YTKxx3t	*Yustak*	6W	4DS	67	.02	0	0	0	67	0
ZIMxxxs	Zinman	3DN	4SD	210	.06	0	0	0	210	0
ZIMxxxt	Zinman	4ND	4SD	42	.01	0	0	0	42	0
ZIMxxxx	Zinman	3D	4SD	576	.17	0	0	0	576	0
ZPIxcxx	Zaplin	2T	3DS	20	.00	0	0	0	0	20
ZPIxxxx	Zaplin	2W	3DS	155	.04	0	0	0	71	84
ZPIxx1x	Zaplin	2X	3DS	6	.00	0	0	0	0	6
ZZZxxxx	Water	7W	4D	10	.00	0	8	0	0	2
TOTALS				325,112	97.74	89,936	92,889	48,535	41,272	52,480
TOTALS				325,112	.00	89,936	92,889	48,535	41,272	52,480

Irrigation Suitability

Irrigation suitability of soils is a relative rating to indicate their limitation for material production, risk of damage or crop losses, and the ability to maintain favorable soil properties under long-term irrigation use. Since the land was mapped on a series-phase bases, a rating for a particular member is provided using pertinent guidelines of Land Classification for Irrigation.

It is emphasized that, at this stage, the properties of the series and phase are rated, not the whole land unit. Therefore, this rating is a first approximation as a general guide to be used in conjunction with adjacent soil members, deeper drill results and land use evaluation in order to make a final land classification rating. More details are provided in references such as PFRA 1964; Michalyna and Smith 1972.

The soils have been given a preliminary or "first approximation" rating base on the soil conditions within the meter depth, soil drainage class and topography (Table 10). These ratings could differ on a final land classification because of additional information of soil conditions within the 3 meter depth of land modification requirements and drainage requirement of the area, and ease of water delivery from planned sources.

The classification of soils for irrigation suitability consist of two categories: class and subclass. The suitability class groups soils having the same relative suitability or degree of limitation or hazard for irrigation use. Four classes are utilized grading from 1, considered very good, to 4, considered poor. The four classes are:

Class 1 - Very good: These are soils of fine sandy loam to clay loam texture which are well suited for irrigation use. The soils have good water retention capacity, good permeability, low salt content, good drainage and low general gradient of land surface.

Class 2 - Good: These are soils of loamy fine sand to light clay texture which are moderately well suited for irrigation use. Slight limitation to use results from soil factors such as water holding capacity, permeability, depth of material, salt content, topographic factors such as slope and pattern or drainage restrictions arising from surface drainage and depth to water table.

Class 3 - Fair: These are coarse or fine textured soils which are fair to marginally suitable because of some unfavourable characteristics that limit production and cause management problems under irrigation use. Soil, topographic or drainage factors are more restrictive than in Class 2.

Class 4 - Poor: These are soils that are considered poor to unsuitable for irrigation use because of severe drainage problems, impermeable geologic material, salinity, very low water holding capacity, very rapid permeability, topography or a combination of these problems.

The suitability subclass identifies soils with similar kinds of limitations and hazards related to both

internal and external soil characteristics. The characteristics are:

S- Soil factors such as texture, water holding capacity, hydraulic conductivity (or permeability) uniformity and depth of geologic deposit, depth to impermeable or slowly permeable layer, level of soluble salts, and relative sodium level (SAR).

T- External features such as those that affect the transport of water and any obstruction to operation of equipment, or affect adequate size of land unit. Factors include type of topography and slope gradients, degree of stones or rocks (the size and shape of the field, surface levelling requirements, and vegetation covering are not included in the rating at this point, but are considered at the next step of land classification).

D- Drainage is rated on the implied internal and surface wetness, as interpreted for the soil series and phase at this stage. (For a land classification, the drainability of the land in conjunction with a satisfactory outlet are also considered).

4.4 SOIL SUITABILITY FOR SELECTED ENGINEERING USES

This section provides information which can be used by engineers and land use planners concerned with engineering and related geotechnical aspects of soil. It is intended to supplement the information on the soil map with additional data on engineering properties of soils.

The criteria used to evaluate soil suitability for selected engineering and related recreational uses are adopted from guides found in Coen et al. 1977, from guidelines developed by the Soil Conservation Service, United States Department of Agriculture 1971, and the Canada Soil Survey Committee 1973.

Definition of Soil Suitability Classes

Evaluation of soil suitability for engineering and recreation uses is based on both internal and external soil characteristcs. Four soil suitability classes are used to evaluate both mineral and organic soils and hence, mapping units for selected uses. These ratings express relative degrees of suitability or limitation for potential uses of natural or essentially undisturbed soils. The long term effects of the potential use on the behavior of the soil are considered in the rating.

The four suitability class ratings are defined as follows:

G- Good: Soils in their present state have few or minor limitations that would affect the proposed use. The limitations would easily be overcome with minimal cost.

F- Fair: Soils in their present state have one or more moderate limitations that would affect the proposed use. These moderate limitations would be overcome with special construction, design, planning or maintenance.

P- Poor: Soils in their present state have one or more severe limitations that would severely affect the proposed use. To overcome these severe limitations would require the removal of the limitation or difficult and costly alteration of the soil or special design or intensive maintenance.

V- Very Poor: Soils have one or more features so unfavorable for the proposed use that the limitation is very difficult and expensive to overcome or the soil would require such extreme alteration that the proposed use is economically impractical.

Soil Suitability Subclasses

The subclasses indicate the basic soil properties that singly or in combination with others commonly affect soil suitability for selected engineering properties and recreation uses. The properties and their respective codes are provided in Table 12.

These subclass designation serve to identify the kind of limitation or hazard for a particular use. For example: Pai for permanent buildings with basements - indicates a soil rating of Poor, due to subgrade properties (a) and flooding hazard (i).

Engineering descriptions and estimated properties significant to engineering for all soils are provided in Table 13. These data, in addition to information contained in other sections of the report, have been used to rate the soils according to their suitability for ten selected engineering uses in Table 13. When using these interpretations, consideration must be given to the following assumptions:

1. Interpretations are based on predictions of soil behavior under defined conditions of use and management as specified in the reference.

2. Soil ratings do not include site factors such as nearness to towns and highways, water supply, aesthetic values, etc.

3. Soil ratings are based on natural, undisturbed soil.

4. Soil suitability ratings are usually given for the entire soil, but for some uses, they may be based on the limitations of an individual soil horizon or other earthy layer, because of its overriding importance. Ratings rarely apply to soil depths greater than 1 to 2 meters, but in some kinds of soils, reasonable estimates can be given for soil material at greater depths. It should be noted here that the term "soil" has been used throughout the report in the pedologic sense and differs in concept from that commonly used by engineers.

5. Poor and very poor soil ratings do not imply that a site cannot be changed to remove, correct or modify the soil limitations. The use of soils rated as poor depends on the nature of the limitations, whether or not the soil limitation can be altered successfully and economically, and on the scarcity of good sites.

6. Interpretations of map units do not eliminate the need for on-site evaluation by qualified professionals. Due to the variable nature of soils and the scale of mapping, small unmappable inclusions of soils with different properties may be present in an area where a development is planned. The need for, or importance of, on-site studies depends on the use to be made of the soil and the kinds of soil and soil problems involved.

4.5 SOIL SUITABILITY FOR SELECTED RECREATION USES

This section provides interpretations of the soil suitability for recreational development. All kinds of soil can be used for recreational activities of some kind.

Soils and their properties determine, to a large degree, the type and location of recreational facilities. Wet soils are not suitable for camp sites, roads, playgrounds or picnic areas. Soils that pond and dry out slowly after heavy rains present problems where intensive use is contemplated. It is difficult to maintain grass cover for playing fields and golf courses on droughty soils. The feasibility of many kinds of outdoor activities are determined by other basic soil properties such as depth to bedrock, stoniness, topography or land pattern, and the ability of the soil to support vegetation of different kinds as related to its natural fertility.

The suitability of the various soil series and phases for selected recreation uses is shown in Table 14 according to four classes G, F, P, and V. (Good, Fair, Poor and Very Poor) defined previously in the section on Engineering Uses. Subclasses are employed to identify the kind of limitation or hazard for a particular use.

TABLE 11

Codes utilized to identify limitations in evaluating soil suitability for selected Engineering and Recreational Uses in Tables 13 and 14

a subgrade properties

b thickness of topsoil

c coarse fragments on surface

d depth to bedrock

e erosion or erodibility

f susceptibility to frost hazard

g contamination hazard of groundwater

h depth to seasonal water table

i flooding or inundation

j thickness of slowly permeable material

k permeability or hydraulic conductivity

l shrink-swell properties

m moisture limitations or deficit

n salinity or sulphate hazard

o organic matter

p stoniness

q depth to sand or gravel

r rockiness

s surface texture

t topographic slope class

u moist consistence

w wetness or soil drainage class

z permafrost

Table 12 Engineering Description of the Soils and Their Estimated Properties Significant to Engineering.

Map Symbol	Soil Series Name	Depth (cm)	Textural Classification			% Passing Sieve			Disturbed Hydraulic Conductivity *(cm/hr)	Reaction (pH)	Electrical Conductivity (mS/cm)	Sulfate-Hazard**	Shrink-Swell Potential	Depth to Seasonal Water Table (m)
			USDA	Unified	AASHO	No. 10 2.0 mm	No. 40 0.42 mm	No. 200 0.074 mm						
ASS	Almassippi	0-20	LFS-FS	SM	-	100	90-100	<35	5-15	7.4-7.8	<0.3	low	low	
		20-60	FS-LFS	(SW) SM	A-2-4	100	100	<35	5-15	7.4-8.2	1.6	mod.	low	0.8
		60-120	FS	(SW) SM	A-2-4,A-3	100	100	<35	5-15	7.4-8.2	1.6	mod.	low	
ASZ	Agassiz	0-25	MSL	SP to GP	-	50-70	20-30	0-15	15-50	7.0-7.5	0.5	none	none	>2
		25-100	S-CoGr	GW to GP	A-1	30-50	30-40	0-15	15-50	7.5-8.0	0.5	none	none	
ATM	Altamont	30-80	CL-C	CL to CH	A-6,A-7	85-95	75-85	60-75	.5-1.5	7.0-7.6	<0.5	low	mod.	>2
		80-100+	L-CL	CL	A-4,A-6	85-95	55-75	40-60	<.15	7.8-8.2	<1	low	mod.	
BEO	Benton	0-40	C	CH	-	100	100	90-100	<.15	7.0-7.4	<0.5	low	high	>1.5
		40-90	C	CH	A-7-6	100	100	90-100	<.15	8.0-9.0	>4	high	high	
		90+	shale											
BIP	Bishop	30-90	C	CH	A-7-6	100	100	90-100	<.15	7.8-8.2	<4	mod.-high	high	some seepage
		90+	shale											
BKA	Birken-head	0-35	FS	SM to SP	-	100	70-85	5-15	15-50	7.6	0.4	low	low	
		35-60	S	SM to SP	A-2-4	95-100	70-85	5-15	15-50	7.8	0.4	low	low	
		60-70	S-FS	SM to SP	A-2-4	95-100	70-85	5-15	15-50	7.9	0.3	low	low	>1.2
		70-90	LS	SM to SP	A-2-4	95-100	70-85	5-15	15-50	7.9	0.3	low	low	
		90-120	FS	SM to SP	A-2-4	95-100	70-85	5-15	15-50	7.9	0.3	low	low	
BMG	Blumengart	0-30	SiC-C	CH to OH	-	100	100	95-100	.15-.5	7.5-7.8	0.5	low	high	0.8
		30-60	SiC-C	CH to MH	A-7-6	100	100	95-100	<.15	7.8-8.1	1.0	mod.	high	
		60-70	SiC-C	CH to MH	A-7-6	100	100	95-100	<.15	7.8-8.1	>2.0	mod.-high	high	
BMF	Blumen-feld	0-45	L	CL to OL	-	100	98-100	55-75	1.5-5	8.0	0.7	mod.	mod.	at
		45-80	VFSL-CL	CL to ML	A-6,A-4	100	98-100	55-75	1.5-5	8.0	1.6	mod.	mod.	surface
		80-120	L-CL	CL to ML	A-6,A-4	100	98-100	50-75	1.5-5	8.0	>1.6	mod.-high	mod.	
BNI	Brundis	30-90	C	CH	A-7-6	100	100	90-100	.15-.5	7.0-7.4	<1.6	low-mod. mod.	high	>2
		90+	shale											
BUM	Blumenort	0-30	SiC-C	CH to OH	-	100	100	95-100	<.15	7.0-7.5	0.5	low	high	at
		30-60	SiC-C	CH to MH	A-7-6	100	100	95-100	<.15	7.8-8.2	>1.6	mod.-high	high	surface
CAV	Carvey	0-25	SCL-L	SC or CL	-	100	80-95	40-75	1.5-5	7.8-8.2	<1.6	mod.	mod.	at or
		25-50	SL-L	SM or CL	A-4,A-6	100	60-95	35-75	5-15	7.8-8.4	<1.6	mod.	mod.	near
		50-100	CS-GrS	SP or GW	A-1	var.	<60	<5	>50	7.8-8.4	<1.6	mod.	low	surface
CZK	Cazlake	30-80	L-CL	ML to CL	A-4,A-6	90-100	85-95	70-90	.15-5	7.8-8.2	<1.6	mod.	mod.	at
		80-100	L-CL	CL	A-4,A-6	85-90	75-95	40-60	.15-5	7.8-8.2	<1.6	mod.	mod.	surface
CTZ	Chortitz	30-60	L-CL	MH-CL	A-7-6,A-6	100	100	98-100	1.5-5	8.0	<0.5	low	mod.	subject
		60-120	L-CL	MH-CL	A-7-6,A-6	100	100	98-100	1.5-5	8.0	<1.6	low-mod.	mod.	to flooding
CXT	Capell	0-20	SCL-L	CL	-	95-100	85-95	40-55	1.5-5.0	7.6-8.0	<1.6	low-mod.	mod.	0.8
		20-40	SCL-L	SC or CL	A-6,A-4	95-100	85-95	30-50	1.5-5	7.8-8.2	<1.6	low-mod.	mod.	
		40-70	Gr-SL	SM	A-1,A-2	-	<50	15-30	15-50	7.8-8.2	<1.6	low-mod.	low	
		70-100	GrS	SP or GP	A-1	-	<45	<5	>50	7.8-8.2	<1.6	low-mod.	low	
CYH	Croyon	0-25	SCL-L	CL	-	100	85-95	60-80	1.5-5	7.2-7.8	<0.5	low	mod.	>2
		25-50	L-CL	CL	A-6	90-100	60-95	35-75	1.5-5	7.8-8.2	<0.5	low	mod.	
		50-100+	CS-GrS	SP	A-1	-	20	<5	>50	7.8-8.2	<0.5	low	low	
DGS	Dugas	0-25	SiC-C	MH to OH	-	100	100	95-100	.15-5	6.5-7.4	<1.6	low-mod.	high	0.8
		25-80	SiC-C	CH	A-7-6	100	100	85-95	.15-5	7.2-7.4	<1.6	low-mod.	high	
		80-100	FS-LVFS	SM to ML	A-2-4,A-4	100	100	15-80	5-15	7.8-8.2	<1.6	low-mod.	low	

Table 12 cont.

Map Symbol	Soil Series Name	Depth (cm)	Textural Classification			% Passing Sieve			Disturbed Hydraulic Conductivity *(cm/hr)	Reaction (pH)	Electrical Conductivity (mS/cm)	Sulfate-Hazard**	Shrink-Swell Potential	Depth to Seasonal Water Table (m)
			USDA	Unified	AASHO	No. 10 2.0 mm	No. 40 0.42 mm	No. 200 0.074 mm						
DNH	Denham	0-30	L-CL	OL	-	100	100	85-100	1.5-5	6.8-7.4	<0.5	low	low-mod.	>1.5
		30-90	VFSL-CL	ML to CL	A-4,A-6	100	100	85-100	1.5-5	7.0-7.4	<0.5	low	low-mod.	
		90-110	C	CH	A-7-6	100	100	90-100	.5-1.5	7.8-8.2	<0.5	low	high	
DOF	Darling-ford	25-70	SiCL-L	ML or CL	A-4,A-6	85-90	75-95	60-85	1.5-5	7.8-8.2	<0.5	low	mod.	>2
		70-100+	CL-L	CL	A-4,A-6	85-90	55-75	40-60	.15-.5	7.8-8.2	<1.6	low-mod.	mod.	
DHO	Deadhorse	0-30	C-SiC	OH	-	100	100	90-100	.5-1.5	6.5-7.4	>2.0	low	high	0.8
		30-60	C-SiC	CH to MH	A-7-6	100	100	90-100	<.5	7.4-8.0	>2.0	low-mod.	high	
		60-120	C-SiC	CH to MH	A-7-6	100	100	90-100	<.5	8.0-8.2	>2.0	high	high	
DEW	Dezwood	25-70	SiCL-L	ML to CL	A-4,A-6	85-90	75-95	60-85	1.5-5	7.8-8.2	<0.5	low	mod.	>2
		70-100+	CL-L	CL	A-4,A-6	85-90	55-75	40-60	<.15-.5	7.8-8.2	<1.6	low-mod.	mod.	
DXM	Druxman	0-20	L-OL	CL	-	100	90-100	70-90	1.5-5	7.0-7.4	<1.6			
		20-55	L-SiL	ML	A-4,A-6	100	90-100	70-90	1.5-5	7.6-8.0	<1.6	low	mod.	>2
		55-80	LS	SM	A-2-4	var.	<60	15-25	15-50	7.6-8.2	<1.6	low	low	
		80-100+	S-Gr	Sp	A-1,A-2	var.	<60	<5	>50	7.8-8.2	<1.6	low	low	
EBG	Edenburg	30-90	CL-SiCL	CL	A-6	100	100	90-100	1.5-5.0	7.0-7.4	< .5	low	mod.	>1.5
		90-110	LFS-FS	SM toML	A-2-4	100	100	10-35	5-15	7.8-8.2	<1.6	low-mod.	low	
EDK	Edkins	0-35	L	OL	-	100	100	55-75	1.5-5	7.4-7.8	<1.6	mod.	mod.-high	at or near surface
		35-85	FSL-SCL	CL to MH	A-6	100	100	60-70	1.5-5	7.8-8.2	<1.6	mod.	mod.-high	
		85-110	C	CH to MH	A-7-6	100	100	100	<0.15	7.8-8.2	>2.0	high	high	
EGF	Eigenhof	0-30	CL	OL to OH	-	100	100	75-100	.5-1.5	6.5-7.4	<0.5	low	mod.-high	2.0
		30-60	CL-SiC	CL to MH	A-7-5	100	95-100	75-95	1.5-5	7.0-7.4	<0.5	low	mod.-high	
		60-120	CL	CL to MH	A-7-5	100	95-100	75-95	.5-1.5	7.6-8.2	<1.6	mod.	mod.	
EEK	Elm Creek	0-30	FS-LFS	SM	-	100	90-100	<35	5-15	6.5-7.4	<0.5	low	low	0.8
		30-90	LFS-LVFS	SM to ML	A-2-4,A-4	100	90-100	40-60	5-15	7.0-7.6	<0.5	low	low	
		90-110	C	CH,MH	A-7-6	100	100	100	<0.1	7.8-8.2	<1.6	low-mod.	high	
FFR	Fifere	30-80	CL	CL to CH	A-6,A-7-6	90-95	80-95	75-90	1.5-5	6.6-7.0	<0.5	low	mod.	>2
		80-100	L-CL	CL	A-6	85-95	80-90	70-85	1.5-5	7.6-8.2	<0.5	low	mod.	
FRS	Ferris	0-40	L-SiCL	OL	-	95-100	85-95	60-95	0.5-1.5	7.6-8.2	<1.6	low	mod.	seasonal
		40-100	L-CL	CL	A-4,A-6	85-95	55-85	40-75	<.5	7.8-8.4	>1.6	low	mod.	0.7
FSO	Fresno	30-80	CL	CL to CH	A-6,A-7	90-95	80-95	75-90	1.5-5	7.0-7.4	<0.5	low	mod.	1.2
		80-110	L-CL	CL	A-6	85-95	80-90	70-85	1.5-5	7.8-8.2	<1.6	low-mod.	mod.	
FTE	Fortier	25-100	SiC-C	MH	A-7-6	100	100	95-100	<.5	7.8-8.2	>1.6	high	high	<1
FWK	Froswick	25-70	SiCL-L	ML to CL	A-4,A-6	85-90	75-95	60-85	1.5-5	7.8-8.2	<1.6	low-mod.	mod.	>1.5
		70-100	CL-L	CL	A-4,A-6	85-90	55-75	40-60	.5-1.5	7.8-8.2	>1.6	mod-high	mod.	periodic seepage
		100+	shale											
GCS	Glencross	0-50	L-CL	CL to OL	-	85-95	80-95	55-75	1.5-5	7.6-8.0	var.	mod.	mod.	0.8
		50-60	GRS	GP	A-1	15-25	<10	<5	>15	7.4-7.8	var.		low	perched
		60-100	L-SiCL	CL or ML	A-4,A-6	80-90	55-85	40-75	.5-1.5	7.8-8.4	>2	high	mod.	
		100+	shale											
GCS1	Glencross substrate variant	0-100	as above											
		100+	limestone layer											
GDH	Gnaden-thal	0-30	L	OL	-	100	100	55-75	1.5-5	6.8-7.4	0.5-1.6	low-mod.	mod.	0.8
		30-60	VFSL-L	ML,CL	A-4,A 6	100	95-100	65-75	1.5-5	8.0-8.2	0.5-1.6	low-mod.	mod.	
		60-120	VFSL-SiCL	ML to CL	A-4,A-6	100	95-100	65-75	0.5-5	8.0-8.2	>1.6	high	mod.	

Table 12 cont.

Map Symbol	Soil Series Name	Depth (cm)	Textural Classification			% Passing Sieve			Disturbed Hydraulic Conductivity *(cm/hr)	Reaction (pH)	Electrical Conductivity (mS/cm)	Sulfate-Hazard**	Shrink-Swell Potential	Depth to Seasonal Water Table (m)
			USDA	Unified	AASHO	No. 10 2.0 mm	No. 40 0.42 mm	No. 200 0.074 mm						
GRA	Gretna	30-60	C	CH	A-7-6	100	100	100	<.15	8.0-8.2	>2	high	high	<1.2
		60-120	C	CH	A-7-6	100	100	100	<.15	8.0-8.2	>2	high	high	
GRR	Guerra	40-70	SiCL-CL	ML or CL	A-4,A-6	85-95	75-85	60-75	<.15	7.8-8.4	>1.6	mod.-high	mod.	at surface
		70-100	L-CL	CL	A-4,A-6	85-90	55-75	40-60	<.15	7.8-8.4	>1.6	mod.-high	mod.	
GVS	Gervais	0-25	SiL-SiCL	MH	-	100	100	90-100	1.5-5	6.8-7.4	<0.5	low	mod.	flood prone
		25-100	VFSL-SiCL	ML to CL	A-4,A-6	100	100	90-100	0.5-5	7.6-8.2	<1.6	low-mod.	mod.	
GYV	Grays-ville	30-90	VFSL-CL	ML to CL	A-5,A-7-6	100	100	65-80	1.5-5	7.6-8.2	<1.6	mod.	mod.	0.8 perched
		90-100	C	CH,MH	A-7-6	100	100	95-100	<.15	7.8-8.2	>1.6	mod.-high	high	
HEB	Hebbot	0-25	CL-L	OL	-	95-100	80-95	60-90	1.5-5	7.2-7.6	<0.5	low	mod.	>1.5
		25-70	SiCL-L	ML or CL	A-4,A-6	85-95	75-85	55-80	1.5-5	7.8-8.2	.5-1.5	low	mod.	
		70-100	CL-L	CL	A-6	85-90	55-80	40-70	<0.5	7.8-8.2	<1.6	low	mod.	
HHF	Hochfeld	0-30	VFS-FSL	SM to SP	-	100	90-100	5-40	5-15	6.5-7.0	<0.5	low	low	0.9
		30-85	VFS-FSL	SM to SP	A-2-4,A-4	100	90-100	30-70	5-15	7.2-7.6	<0.5	low	low	
		85-110	FS-LVFS	SM to ML	A-2,A-4	100	90-100	20-70	5-15	7.8-8.2	<1.6	low-mod.	low	
HIN	Hibsin	0-30	FS	SM	-	100	90-100	1-10	5-15	6.5-7.4	<0.5	low	low	>1.5
		30-85	VFS-FSL	SM to SP	A-2,A-4	100	90-100	25-70	5-15	7.2-7.6	<0.5	low	low	
		85-100	SiC-C	CH,MH	A-7-6	100	100	95-100	.15-.5	7.8-8.2	<1.6	low-mod.	high	
HND	Horndean	30-80	C-SC	CH,MH	A-7-6	100	100	85-95	.15-.5	7.2-7.6	<1.6	low-mod.	high	1.2
		80-110	FS-LVFS	SM to ML	A-2,A-4	100	100	40-70	5-15	7.8-8.2	>2	mod.-high	low	
HOS	Horose	0-25	L	OL	-	80-95	75-95	60-85	1.5-.5	7.2-7.6	< .5	low	low	at surface
		25-75	L-C	ML to CH	A-4,A-7	80-95	70-75	60-85	<.5	7.2-7.8	>1.6	low-mod.	mod.-high	
		75-110	L-CL	CL	A-4,A-6	80-90	55-75	40-65	.15-5	7.9-8.2	>2	mod.-	mod. high	
JIS	Jirose	40-100	L-CL	CL	A-4,A-6	85-95	55-85	40-75	<.5	7.8-8.2	>2	mod.-high	mod.	possible seepage
		100+	shale											
JOD	Jordan	30-85	SiC-C	CH,MH	A-7-6	100	100	85-95	1.5-5	7.0-7.6	< .5	low	high	>1.5
		85-110	FS-LVFS	SM to ML	A-2,A-4	100	100	15-70	5-15	7.8-8.2	<1.6	low-mod.	low	
JST	Jasset	30-80	VFSL-L	ML to CL	A-5	100	95-100	65-75	1.5-5	7.0-7.4	<0.5	low	mod.	1.2
		80-110	FS-LVFS	SM to ML	A-2,A-4	100	100	15-70	5-15	7.8-8.2	<1.6	low-mod.	low	
JYL	Joyale	30-60	SiCL-CL	ML or CL	A-4,A-6	85-95	75-85	60-75	<.5	7.8-8.2	<1.6	mod.	mod.	0.8
		60-100+	L-CL	CL	A-4,A-6	85-90	55-75	40-60	<.5	7.8-8.2	>2	high	mod.	
KDA	Klidal	25-90	C	CH	A-7-6	95-100	85-95	70-90	<.15	7.4-7.8	>2	high	high	seepage
		90+	shale									high		
KIS	Kingsley	40-70	L-SiCL	ML or CL	A-4,A-6	85-95	75-85	60-75	1.5-5	7.0-7.6	<1	low	mod.	>2
		70-100+	L-CL	CL	A-4,A-6	85-95	55-75	40-60	<.5	7.2-7.8	<1	low	mod.	
KOT	Kronstal	0-40	FSL	SM	-	100	95-100	5-35	5.0-15.0	6.5-7.4	<0.5	low	low	<1.2
		40-90	VFS-FSL	ML,SM	A-4,A-2-4	100	100	25-60	5.0-15.0	7.0-7.4	<0.5	low	low	
		90-110	FS-LFS	SM,SW	A-2-4,A-3	100	95-100	15-35	15.0-35.0	7.8-8.2	<1.6	low-mod.	low	
KUD	Knudson	0-50	CL	CL-OL	-	100	100	70-85	1.5-5	7.2-7.6	<0.5	low	mod.	>1.5
		50-70	SiCL	ML or CL	A-4,A-6	85-90	75-85	60-75	1.5-5	7.8-8.2	<0.5	low	mod.	
		70-100	L-CL	CL	A-4,A-6	85-90	55-75	40-60	.15-5	7.8-8.2	<1.6	low	mod.	

Table 12 cont.

Map Symbol	Soil Series Name	Depth (cm)	Textural Classification			% Passing Sieve			Disturbed Hydraulic Conductivity *(cm/hr)	Reaction (pH)	Electrical Conductivity (mS/cm)	Sulfate-Hazard**	Shrink-Swell Potential	Depth to Seasonal Water Table (m)
			USDA	Unified	AASHO	No. 10 2.0 mm	No. 40 0.42 mm	No. 200 0.074 mm						
LAY	Layland	0-30	FS	SM	-	100	90-100	1-10	5-15	7.4-7.8	<0.5	low	low	at
		30-90	LVFS	SM to ML	A-4	100	100	40-70	5-15	7.8-8.2	<1.6	mod.	low	surface
		90-110	C	CH,MH	A-7-6	100	100	100	<.15	7.8-8.2	<1.6	mod.	high	
LEI	Levine	20-100	strat. SiL-CL	ML to CL	A-4,A-7-6	100	100	65-100	.5-1.5	7.8-8.4	<1.6	low-mod.	mod.	flood prone
LEW	Loeven	30-60	L-CL	MH to CL	A-7-6	100	100	98-100	.5-1.5	7.4-8.2	<1.6	mod.	mod.-high	flood prone
		60-120	L-CL	MH to CL	A-7-6	100	100	98-100	<.5	7.4-8.2	>2	mod.-high	mod.-high	
LLT	Lelant	0-30	FSL	OL	-	100	100	15-50	5-15	7.8-8.2	<1.6	low-mod.	low	at
		30-60	FS-FSL	SM,ML	A-2-4	100	100	10-50	1.5-5	7.8-8.2	<1.6	low-mod.	low	surface
		60-120	FS-LFS	SM(SW)	A-2-4	100	100	5-35	5-15	7.8-8.2	<1.6	low-mod.	neg.	
LOP	Longplain	0-25	FS-LFS	SM	-	100	100	1-10	15-50	6.8-7.4	<0.5	low	neg.	1.2
		25-70	LFS-FS	SM	A-2-4	100	100	5-35	15-50	7.0-7.4	<0.5	low	neg.	
		70-110	FS	SM(SW)	A-2-4,A-3	100	100	5-35	15-50	7.8-8.2	<0.5	low	neg.	
LRY	Leary	0-25	LFS	SM	-	85-100	90-100	10-20	5-15	7.4 7.8	<0.5	low	neg.	>2
		25-75	GrLS-FGr	GW or GP	A-1	35-60	-	<5	>15	7.8-8.4	<0.5	low	neg.	
		75-110+	S-Gr	GW or GP	A-1	35-60	-	<5	>15	7.8-8.4	<1	low	neg.	
MFI	Mansfield	0-20	M-CS	Sp	-	90-100	40-75	<5	>15	6.8-7.4	<0.3	low	neg.	>0.8
		20-50	GrLS-GrS	GP or SP	A-1	35-60	-	<5	>15	7.8-8.4	<0.3	low	neg.	
		50-100	S-Gr	GP or Sp	A-1	35-60	-	<5	>50	7.8-8.4	<0.5	low	neg.	
MOW	Mowbray	30-100	SiL-CL	ML,CL	A-4,A-6	100	85-95	65-90	.5-1.5	7.4-7.8	<0.5	low	low-mod.	>1.5
MRH	Marring-hurst	0-25	LFS-FSL	SM to SP	-	100	90-100	10-35	>15	7.4-7.8	<0.5	low	neg.	>2
		25-55	GrLS-GrS	GP or SP	A-1	35-60	-	<5	>15	7.8-8.0	<0.5	low	neg.	
		55-100	S-Gr	GP or SP	A-1	35-60	-	<5	>15	7.8-8.0	<0.5	low	neg.	
MRS	Morris	30-65	C	CH	A-7-6	100	100	100	<.15	7.0-7.4	<1.6	low-mod.	high	<1.5
		65-100	C	CH	A-7-6	100	100	100	<.15	7.8-8.2	>1.6	high	high	
MXS	Manitou	40-80	L-C	ML to MH	A-6,A-7-6	95-100	85-95	65-80	1.5-5	6.7-7.3	<.5	low	mod.	>2
		80-110	L-CL	ML to MH	A-6,A-7-6	90-100	75-90	60-80	1.5-5	7.8-8.2	<.5	low	mod.	
NBG	Neuenberg	0-40	L	OL to ML	-	100	100	55-75	1.5-5	7.2-7.6	1.6	mod.	low	1.0
		40-90	VFSL-L	ML to CL	A-4,A-6	100	100	40-60	1.5-5	7.6-8.0	1.6	mod.	low-mod.	
		90-120	FS-LVFS	SM to ML	A-2-4,A-4	100	100	50-75	5-15	7.8-8.2	>1.6	mod.-high	low	
NKK	Nikkel	40-100	L-CL	CL	A-4,A-6	85-95	55-85	40-75	<1.5	7.8-8.4	<1.6	low-mod.	mod.	1.2
NOW	Novell	40-80	L-CL	ML to MH	A-4,A-7-6	95-100	85-95	65-80	1.5-5	6.8-7.2	<.5	low	mod.	1.2
		80-110	L-CL	ML to MH	A-4,A-7-6	90-100	75-90	60-80	.5-1.5	7.8-8.2	<1.6	low-mod.	mod.	
NSH	Narish	40-70	SiCL-CL	ML or CL	A-4,A-6	85-95	75-85	60-75	.5-1.5	7.8-8.4	<1.6	low-mod.	mod.	at
		70-110	L-CL	CL	A-4,A-6	85-95	55-75	40-60	<.5	7.6-8.2	<1.6	low-mod.	mod.	surface
NTO	Nanton	60-100	L-SiCL	CL or ML	A-4,A-6	80-90	55-85	40-75	.5-1.5	7.8-8.4	1.6	mod.	mod.	1.2
		100+	shale											at surface
NUH	Neuhorst	30-70	CL,SiCL	CL to CH	A-7-5,A-7-6	100	100	70-90	.5-5	7.8-8.2	1.6	mod.	mod.	1.2
		70-110	strat. SiL-CL	ML to CL	A-4,A-6	100	100	70-90	.5-5	7.8-8.2	>1.6	mod.-high	mod.	

Table 12 cont.

Map Symbol	Soil Series Name	Depth (cm)	Textural Classification			% Passing Sieve			Disturbed Hydraulic Conductivity *(cm/hr)	Reaction (pH)	Electrical Conductivity (mS/cm)	Sulfate-Hazard**	Shrink-Swell Potential	Depth to Seasonal Water Table (m)
			USDA	Unified	AASHO	No. 10 2.0 mm	No. 40 0.42 mm	No. 200 0.074 mm						
HWN	Hewton Siding	0-20 20-80 80-120	CL CL FS-LVFS	ML to CL MH to CH SM to ML	- A-7-5 A-2-4,A-4	100 100 100	100 100 100	90-100 70-90 40-70	.5-1.5 S-1.5 S-15	7.2-7.6 7.4-7.8 7.6-8.2	<1.6 <1.6 <1.6	low-mod. low-mod. mod.	mod. mod. low	1.0
OAY	Oakley	25-70 70-100 100+	SICL-L CL-L shale	ML or CL CL	A-4,A-6 A-4,A-6	85-90 85-90	75-95 55-75	60-85 40-60	1.5-5 .5-1.5	7.8-8.2 7.8-8.2	.5 .5	low low	mod. mod.	>2
OBO	Osborne	0-35 35-100	C C	OH CH	- A-7-6	100 100	100 100	100 100	0.15-.5 .15	6.5-7.4 7.8-8.2	<1.6 <1.6	mod. mod.	high high	surface ponding
OWR	Oster-wick	0-60 60-100 100-140	FSL FSL FS-FSL	SM SM SM to ML	- A-4 A-4,A-2-4	100 100 100	95-100 100 100	S-35 35-60 35-60	S-15 5-15 5-15	7.4-7.8 8.0-8.2 8.0-8.2	<0.5 <1.6 <1.6	low low-mod. low-mod.	low low low	at surface
PBI	Pembina	25-70 70-100+	CL-C L-CL	MH to CL CL	A-6,A-7-6 A-4,A-6	85-90 85-90	75-95 55-75	60-85 40-60	1.5-5.0 <.5-1.5	7.4-7.8 7.8-8.2	<0.5 <0.5	low low	mod.-high mod.	>2
PER	Perillo	0-60 60-85 85-125	OH FSL-SIL FS-SIL	Pt OL SM to ML	- - A-2-4,A-4	- 100 100	- 100 100	- 40-95 25-90	- 0.5-5 1.5-15.0	7.8-8.2 7.8-8.2 7.8-8.2	- <1.6 <1.6	- mod. mod.	- low low	at surface
PGK	Pigeon Lake	30-90 90-110	VFSL-SICL SIC-C	ML to CL MH-CH	A-4,A-6 A-7-6	100 100	100 100	75-100 100	.5-5 <.15	7.8-8.2 7.8-8.2	<1.6 <1.6	low-mod. low-mod.	mod. high	.9 perched
PHE	Plum Coulee	30-60 60-120	C SICL-C	CH MH to CH	A-7-6 A-7-6	100 100	100 100	95-100 90-100	.5-1.5 .15-.5	7.5-7.8 7.8-8.0	<1.6 >1.6	low-mod. mod.-high	high high	1.2
POU	Pouchal	25-70 70-110	CL-C L-CL	CL,CH,MH CL	A-6,A-7-6 A-6,A-7-6	90-95 90-95	85-95 80-90	70-90 60-85	<.15 .15-.5	7.0-7.4 7.8-8.2	<.5 <.5	low low	high mod.	at surface
PYR	Poyser	25-70 70-100	SICL-CIL-C CL	CL to CH CL to CH	A-7-6 A-6,A-76	85-90 85-90	75-95 55-75	60-85 40-60	1.5-5 .5-1.5	7.8-8.2 7.8-8.2	<.5 <.5	low low	high mod-high	>2
RBK	Rosebank	0-30 30-85 85-110	FS-FSL LFS-LVFS C,SIC	SM to ML SM to ML CH,MH	- A-2-4,A-4 A-7-6	100 100 100	90-100 90-100 100	<35 40-60 95-100	S-15 S-15 <.15	7.4-7.8 7.8-8.2 7.8-8.2	<0.5 <1.6 >1.6	low low-mod. mod.-high	low low high	0.8 perched
RFD	Reinfeld	0-50 50-90 90-100	L VFSL-L VFS-SICL	OL ML,CL ML to MH	- A-4,A-6 A-4,A-6	100 100 100	95-100 100 100	55-75 70-95 70-95	S-15 1.2-5 .5-5	6.5-7.4 7.8-8.2 7.8-8.2	<0.5 <0.5 <1.6	low low low-mod.	mod. mod. mod.	1.5
RGD	Rignold	0-40 40-90 90-110	L VFSL-CL C	OL ML to CL CH,MH	- A-4,A-6 A-7-6	100 100 100	95-100 100 100	55-75 70-100 100	1.5-5 1.5-5 <.15	6.5-7.4 7.4-8.0 7.8-8.2	<0.5 <0.5 <1.6	low low low-mod.	mod. mod. high	0.8 (perched)
RIV	Red River	30-100 100-150	C C	CH CH	A-7-6 A-7-6	100 100	100 100	100 100	.15-5 .15-5	7.6-8.2 7.8-8.2	1.6 3-5	mod. high	high high	1.5
RLD	Reinland	0-30 30-75 75-110	FSL FSL-LVFS FS-LVFS	SM SM to ML SM to ML	- A-2-4,A-4 A-2-4,A-4	100 100 100	95-100 95-100 95-100	S-35 30-85 25-75	S-15 S-15 S-15	7.2-7.6 7.8-8.2 7.8-8.2	<1.6 <1.6 1.6	low-mod. low-mod. mod.	low low low	1.2
RSG	Rosen-gart	0-35 35-80 80-110	L-CL VFSL-L-SIL FS-LVFS	OL ML SM to ML	A-4,A-6 A-4 A-2-4,A-4	100 100 100	95-100 100 100	55-75 90-100 25-75	1.5-5 1.5-5 S-15	6.5-7.4 7.2-7.8 7.8-8.2	<0.5 <0.5 <1.6	low low low-mod.	low low low	>1.5
RSI	Rosslale	30-75 75-110 110+	L-CL CL shale	ML to CL CL to CH	A-4,A-6 A-6,A-7-6	75-95 85-90	70-90 55-75	60-85 40-60	1.5-5 <.5	7.47.8 7.8-8.2	< .5 <1.6	low low-mod.	mod. mod.	>2

Table 12 cont.

Map Symbol	Soil Series Name	Depth (cm)	Textural Classification			% Passing Sieve			Disturbed Hydraulic Conductivity *(cm/hr)	Reaction (pH)	Electrical Conductivity (mS/cm)	Sulfate-Hazard**	Shrink-Swell Potential	Depth to Seasonal Water Table (m)
			USDA	Unified	AASHO	No. 10 2.0 mm	No. 40 0.42 mm	No. 200 0.074 mm						
SCK	Stockton	0-30	LFS	SM to SP	-	100	85-95	5-35	5-15	6.8-7.2	<0.5	low	neg.	2
		30-75	LFS-FS	SM	A-2-4	100	95-100	15-35	5-15	6.8-7.2	<0.5	low	neg.	
		75-110	FS-LFS	SM(SW)	A-2-4,A-3	100	80-95	10-35	15-50	7.8-8.2	<0.5	low	neg.	
SKL	Skelding	0-25	FS	SM	-	100	100	<10	>15	6.5-7.4	<0.1	low	neg.>2	
		25-100	FS	SM,SW	A-2,A-3	100	70-100	<10	>15	6.5-7.4	<0.1	low	neg.	
SQR	Squirrel Creek	0-25	L-CL	ML	A-4,A-5	100	100	25-40	1.5-5	7.4-8.2	1.6	low	low	0.8
		25-85	SiL-L	ML	A-4	100	95-100	40-70	<1.5	8.0-8.2	>1.6	high	low	perched
		85-110	C,SiC	CH,MH	A-7-6	100	100	100	<.15	7.8-8.2	>1.6	high	high	
SUE	St. Claude	0-25	L-CL	ML	A-4,A-5	100	100	25-40	1.5-5	7.4-8.2	>1.6	low	low	0.8
		25-75	SiL-L	ML	A-4	100	95-100	40-70	0.5	8.0-8.2	1.6	mod.-high	low	
		75-110	FS-LFS	SM	A-2-4,A-3	100	85-100	<35	5-15	7.8-8.2	1.6	mod.	low	
SXG	Stellar	0-30	L-CL	CL	-	85-95	80-90	60-85	>1.5	6.8-7.4	<.5	low	mod.-high	>2
		30+	shale											
TLI	Tellier	40-80	L-SiCL	CL or ML	A-4	85-100	75-95	60-90	.5-1.5	7.8-8.2	<.5	low	mod.	1.2
		80-100+	L-CL	CL	A-4,A-6	85-90	55-80	40-70	<.15-5	7.8-8.2	<1.6	low-mod.	mod.	
TNT	Trinton	30-70	FSL-L	ML	A-6,A-4	95-100	90-100	85-95	1.5-5.0	6.6-7.2	<0.5	low	mod.	>1.5
		70-110	CS-GrS	GP,SP	A-1	35-60	-	<5	>50	7.8-8.2	<0.5	low	neg.	
ULH	Ullrich	40-80	CL-C	CL,CH	A-6	85-100	75-95	60-90	.5-1.5	7.8-8.2	<0.5	low	mod.	1.2
		80-100	L-CL	CL	A-4,A-6	85-90	55-80	40-70	.15-.5	7.8-8.2	<1.6	low-mod.	mod.	
VDL	Vandal	30-70	FSL-L	ML	A-4,A-6	95-100	90-100	35-80	5-15	6.6-7.2	<0.5	low	low	>1.5
		70-110	S-GrS	GW,GP	A-1	35-60	-	<5	>50	7.8-8.2	<0.5	low	low	
VTL	Vartel	0-30	L-CL	CL	-	90-100	80-95	65-90	1.5-5	6.6-7.2	<0.5	low	mod.	<1
		30-70	L,SiL	ML	A-4,A-6	95-100	90-100	85-95	1.5-5	7.8-8.0	<0.5	low	low	
		70-110	CS-GrS	GP,SP	A-1	35-60	-	<5	>50	7.8-8.2	<0.5	low	low	
WIK	Winkler	0-30	CL-C	CH	-	100	100	90-100	1.5-5	6.8-7.0	<0.5	low	high	2
		30-60	C	CH	A-7-6	100	100	90-100	1.5-5	7.5-7.8	<0.5	low	high	
		60-120	SiCL-C strat.	CH,MH	A-7-6	100	100	90-100	.15-.5	7.8-8.0	1.6	low-mod.	high	
WIK2	Winkler Var.	30-60	C	CH	A-7-6	100	100	100	.5	7.5-7.8	<1.6	low-mod.	high	>2
		60-120	C	CH	A-7-6	100	100	100	<.5	7.8-8.0	>1.6	high	high	
WOR	Worden	20-60	CL-SiCL	CL	A-6,A-7	100	95-100	80-90	1.5-5	7.4-7.8	<0.5	low	mod.	>2
		60-100+	SiL-CL	ML or CL	A-4,A-7-6	90-100	90-100	70-85	.5-1.5	8.2	<0.5	low	mod.	
WWB	Willow-bend	0-35	L-CL	OL,OH	-	100	100	65-100	-	6.5-7.4	<1.6	low	low	flood
		35-100	strat. FS-SiCL	ML,CL	A-4,A-6	100	100	30-100	variable	7.8-8.2	<1.6	low-mod.	low-mod.	prone
WWC	Willow-crest	0-60	FS-LFS	SM	-	100	100	<35	5-15	6.5-7.4	<0.5	low	neg.	1.2
		60-120	FS-LFS	SM,SW	A-2-4,A-3	100	100	5-35	5-15	7.8-8.2	<0.5	low	neg.	
XVI	Xavier	0-130	Om	Pt	-	-	-	-	-	7.8-8.2	1.6	mod.		at
		130-150	FS-SiL	SM,ML	A-2-4,A-4	100	100	25-90	1.5-15.0	7.8-8.2	1.6	mod.	low	surface
YTR	Yuster	30-80	L-SiL	ML,CL	A-4,A-6	95-100	90-100	85-95	1.5-5	7.2-7.6	<1.0	low	mod.	at
		80-110	S-GrS	GW,GP	A-1	35-60	-	<5	>50	7.8-8.2	1.6	low-mod.	low	surface
ZIM	Zinman	25-70	CL-C	CH	A-7-6	95-100	90-100	75-90	<.15	7.8-8.4	>2.0	high	high	1.2
		70-110	L-CL	CL	A-4,A-6	85-90	55-80	40-70	.15-.50	8.2	>2.0	high	mod.	seepage
ZPI	Zaplin	0-40	L-SiCL	CL,ML	-	95-100	85-95	60-95	.5-5	7.6-8.0	<1.6	low	mod.	<1.2
		40-100	L-CL	CL	A-4,A-6	85-95	55-85	40-75	<.5-1.5	7.8-8.4	<1.6	mod.	mod.	

Table 12 cont.

Soil Series with saline phases "s" "t" and "u" rate "SULPHATE HAZARD' high

* Disturbed hydraulic conductivity is expressed in cm/hr

** Sulfate Hazard - relative degree of sulfate attack on concrete based on criteria established by U.S. Bureau of Reclamation.

very rapid	>50 cm/hr	moderate	1.5-5 cm/hr
rapid	15-50 cm/hr	moderately slow	.5-1.5 cm/hr
moderately rapid	5-15 cm/hr	slow	.15-.5 cm/hr
		very slow	<.15

TABLE 13. SUITABILITY RATINGS OF SOILS FOR SELECTED ENGINEERING USES

Map Symbol and Phase	Soil Name	Top Soil	Sand & Gravel	Road Fill	Permanent Bldgs. With Basements	Local Roads and Streets	Sanitary Trench	Landfill Area	Cover Material	Sewage Lagoons	Septic Fields
ARN	Aronet	Ps	Pa	Va	Fw	Va	Vs	Pk	Fs	Vk	Gg
ARN /xcxx	Aronet	Ps	Fa	Va	Fw	Va	Vs	Pk	Fs	Vk	Gg
ARN /xdxx	Aronet	Ps	Pq	Va	Fw	Va	Vs	Pk	Fs	Vk	Gg
ASS	Almasippi	Ps	Pa	Fw	Pw	Fw	Vs	Pk	Fs	Vkh	Ph
ASS /lxxx	Almasippi	Ps	Pa	Fw	Pw	Fw	Vs	Pk	Fs	Vkh	Ph
ASS /0xxx	Almasippi	Ps	Paq	Fw	Pw	Fw	Vs	Pk	Fs	Vkh	Ph
ASS /xcxx	Almasippi	Ps	Pa	Fw	Pw	Fw	Vs	Pk	Fs	Vkh	Ph
ASS /lcxx	Almasippi	Ps	Pa	Fw	Pw	Fw	Vs	Pk	Fs	Vkh	Ph
ASS /xxxs	Almasippi	Pns	Pa	Fw	Pw	Fw	Vs	Pk	Fs	Vkh	Ph
ASS1	Almasippi	Ps	Faq	Fw	Pw	Fw	Vs	Pk	Fs	Vk	Ph
ASZ	Agassiz	Ps	G	G	G	G	Vsk	Vk	Vs	Vak	Gg
ASZ /xcxx	Agassiz	Ps	G	G	G	G	Vs	Vk	Vs	Vak	Gg
ASZ /xc2x	Agassiz	Ps	G	G	G	G	Vs	Vk	Vs	Vak	Gg
ATN	Altamont	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fa	Fk
ATN /xcxx	Altamont	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fa	Fk
ATN /xc1x	Altamont	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fa	Fk
ATN /1c2x	Altamont	Fps	Va	Fa	Fap	Fa	Fps	G	Fs	Fkt	Fk
BEO	Benton	Ps	Va	Pa	Pad	Pa	Vd	G	Pds	G	Vk
BEO /xc1x	Benton	Ps	Va	Pa	Pad	Pa	Vd	G	Pds	Pt	Vk
BEO /xc2x	Benton	Ps	Va	Pa	Pad	Pa	Vd	G	Pds	Ft	Vk
BEO /xc4x	Benton	Psp	Va	Pap	Pad	Pap	Vd	G	Pds	Pp	Vk
BEO /xdxx	Benton	Ps	Va	Pa	Pad	Pa	Vd	G	Pds	Pt	Vk
BEO /xd1x	Benton	Ps	Va	Pa	Pad	Pa	Vd	G	Pds	Pt	Vk
BIP	Bishop	Ps	Va	Pa	Paw	Pa	Vd	Fw	Pds	G	Pkd
BIP /xxxs	Bishop	Ps	Va	Pa	Paw	Pa	Vd	Fw	Pds	G	Pkd
BKA	Birkenhead	Ps	G	G	G	G	Vks	Vk	Vs	Vk	Gg
BKA /xcxx	Birkenhead	Ps	G	G	G	G	Vks	Vk	Vs	Vk	Gg
BKA /xc2x	Birkenhead	Ps	G	G	Fp	G	Vks	Vk	Vs	Vk	Gg
BKA /xdxx	Birkenhead	Ps	G	G	G	G	Vsk	Vk	Vs	Vk	Gg
BKR	Basker	Pi	Va	Pw	Vi	Vi	Vi	Viw	Pw	Vi	Vi

TABLE 13. SUITABILITY RATINGS OF SOILS FOR SELECTED ENGINEERING USES

Map Symbol and Phase	Soil Name	Top Soil	Sand & Gravel	Road Fill	Permanent Bldgs. With Basements	Local Roads and Streets	Sanitary Trench	Landfill Area	Cover Material	Sewage Lagoons	Septic Fields
BMG	Blumengart	Ps	Va	Pa	Paw	Pa	Phs	Fw	Pw	G	Pki
BMG /xxxs	Blumengart	Pns	Va	Pa	Paw	Pa	Phs	Fw	Pw	G	Pki
BMG /xxxt	Blumengart	Vn	Va	Pa	Paw	Pa	Phs	Fw	Pw	G	Pki
BNF	Blumenfeld	Fs	Va	Pw	Vw	Pw	Phw	Pw	Pw	Vh	Vh
BNF /xxxs	Blumenfeld	Pn	Va	Pw	Vw	Pw	Vhw	Pw	Pw	Vh	Vh
BNF /xxxt	Blumenfeld	Vn	Va	Pw	Vw	Pw	Vhw	Pw	Pw	Vh	Vh
BNF /xxxu	Blumenfeld	Vn	Va	Pw	Vw	Pw	Vhw	Vhw	Pw	Vh	Vh
BNFd /xxxs	Blumenfeld	Fs	Va	Pw	Pw	Pw	Vhw	Vhw	Pw	Vh	Vh
BNFd	Blumenfeld	Fs	Va	Pw	Pw	Pw	Vhw	Vw	Pw	Vh	Vh
BNFp	Blumenfeld	Fs	Va	Pw	Pw	Vw	Vw	Vw	Pw	Vh	Vh
BNI	Brundis	Ps	Va	Pa	Pa	Pa	Vd	G	Pds	G	Pkd
BNI /xdxx	Brundis	Ps	Va	Pa	Pa	Pa	Vd	G	Pds	Pt	Pkd
BUM	Blumenort	Psw	Va	Pwa	Vh	Paw	Vhw	Pwi	Psw	Fh	Vkh
BUM /xxxs	Blumenort	Pnw	Va	Pwa	Vh	Paw	Vhw	Pwi	Psw	Fh	Vkh
BUM /xxxt	Blumenort	Vn	Va	Pwa	Vh	Paw	Vhw	Pwi	Psw	Fh	Vkh
BUMp	Blumenort	G	Va	Pwa	Vh	Vw	Vhw	Vsw	Vs	Fh	Vkh
CAV	Carvey	Fs	Phq	Pw	Pw	Pw	Vwg	Vhg	Pw	Vh	Vhg
CAVp	Carvey	G	Fa	Vw	Vw	Pw	Vwg	Vwk	Vw	Vkh	Vhg
CTZ	Chortitz	Pi	Va	Faw	Piw	Pi	Piw	Pi	Fs	Vi	Pi
CTZ /xxxs	Chortitz	Pn	Va	Faw	Pw	Pi	Fsw	Fw	Fs	Fak	Pi
CXT	Capell	Fb	Faq	Fw	Pw	Fwa	Vsk	Pk	Ps	Vka	Phg
CXT /xxlx	Capell	Fbs	G	Fw	Pw	Fwa	Vsk	Pk	Ps	Vka	Phg
CYN	Croyon	Fbs	G	G	G	Fa	Vsk	Vkg	Ps	Vka	Gg
CYN /xcxx	Croyon	Fbs	Fq	G	G	G	Vsk	Vkg	Ps	Vka	Gg
CZK	Cazlake	Fs	Va	Vh	Vh	Vw	Vhw	Vh	Pw	Fhk	Vh
CZK /xxxs	Cazlake	Pn	Va	Vh	Vh	Vw	Vhw	Vh	Pw	Fhk	Vh
DGF	Darlingford	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fk	Fk
DGF /xxlx	Darlingford	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fk	Fk
DGF /lxlx	Darlingford	Pb	Va	Fa	Fa	Fa	Fs	G	Fs	Fk	Fk
DGF /xx2x	Darlingford	Fps	Va	Fa	Fap	Fa	Fps	G	Fsp	Fk	Fk

TABLE 13. SUITABILITY RATINGS OF SOILS FOR SELECTED ENGINEERING USES

Map Symbol and Phase		Soil Name	Top Soil	Sand & Gravel	Road Fill	Permanent Bldgs. With Basements	Local Roads and Streets	Sanitary Trench	Landfill Area	Cover Material	Sewage Lagoons	Septic Fields
DGF	/xc1x	Darlingford	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fkt	Fk
DGF	/2cxx	Darlingford	Vb	Va	Fa	Fa	Fa	Fs	G	Fsp	Fkt	Fk
DGF	/2c1x	Darlingford	Vb	Va	Fa	Fa	Fa	Fs	G	Fs	Fkt	Fk
DGS		Dugas	Ps	Va	Fwa	Pwa	Pa	Ps	Fw	Ps	Pk	Fk
DGS	/xxxs	Dugas	Psn	Va	Fwa	Pwa	Pa	Ps	Fw	Ps	Pk	Fk
DGS	/xxxt	Dugas	Vn	Va	Fwa	Pwa	Pa	Ps	Fw	Ps	Pk	Pkh
DHO		Deadhorse	Fs	Va	Pa	Pwa	Pa	Ps	Fw	Ps	Fkh	Pkh
DHO	/xxxs	Deadhorse	Psn	Va	Pa	Pwa	Pa	Ps	Fw	Ps	Fh	Pkh
DHO1		Deadhorse	Fs	Va	Pa	Pwa	Pa	Ps	Fw	Ps	Fkh	Pkh
DNH		Denham	G	Va	Fa	Pa	Fa	Ps	G	G	Fa	Pd
DNH	/xcxx	Denham	G	Va	Fa	Pa	Fa	Ps	G	G	Fa	Pd
DNH	/0xxx	Denham	G	Va	Fa	Pa	Fa	Ps	G	G	Fa	Pd
DOB		Dobbin	Ps	Pa	G	G	G	Fs	Pk	Fs	Pk	Gg
DXM		Druxman	Fs	Fq	Fw	Pw	Fw	Vsg	Vkg	Vs	Vkg	Phg
DZW		Dezwood	Fsb	Va	Fa	Fa	Fa	Fs	G	Fs	Fk	Fk
DZW	/xx1x	Dezwood	Fsb	Va	Fa	Fa	Fa	Fs	G	Fs	Fk	Fk
DZW	/xcxx	Dezwood	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fkt	Fk
DZW	/1cxx	Dezwood	Pb	Va	Fa	Fa	Fa	Fs	G	Fs	Fkt	Fk
DZW	/xc1x	Dezwood	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fkt	Fk
DZW	/1c1x	Dezwood	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fkt	Fk
DZW	/xc2x	Dezwood	Fsp	Va	Fa	Fap	Fa	Fsp	G	Fsp	Fk	Fk
DZW	/xdxx	Dezwood	Fst	Va	Fa	Fa	Fa	Fs	G	Fs	Pt	Fk
DZW	/1dxx	Dezwood	Fst	Va	Fa	Fa	Fa	Fs	G	Fs	Pt	Fk
DZW	/xd1x	Dezwood	Fst	Va	Fa	Fa	Fa	Fs	G	Fs	Pt	Fk
DZW	/xd2x	Dezwood	Ftp	Va	Fa	Fap	Fa	Fsp	G	Fsp	Pt	Fk
DZW	/xexx	Dezwood	Pt	Va	Fa	Fat	Fat	Fs	Ft	Fts	Vt	Fkt
EBG		Edenburg	Fs	Va	Fa	Fa	Fa	Pk	Fk	Fs	Pka	G
EDK		Edkins	Fsb	Va	Pw	Vw	Pw	Vw	Pw	Pw	G	Vh
EDK	/xxxs	Edkins	Pn	Va	Pw	Vh	Pw	Vw	Pw	Pw	G	Vh
EDKd		Edkins	G	Va	Pw	Vh	Vaw	Vw	Vw	Pw	G	Vh

TABLE 13. SUITABILITY RATINGS OF SOILS FOR SELECTED ENGINEERING USES

Map Symbol and Phase	Soil Name	Top Soil	Sand & Gravel	Road Fill	Permanent Bldgs. With Basements	Local Roads and Streets	Sanitary Trench	Landfill Area	Cover Material	Sewage Lagoons	Septic Fields
EDKdp	Edkins	G	Va	Pw	Vh	Vaw	Vw	Vw	Pw	G	Vh
EEK	Elm Creek	Ps	Pa	Fw	Pw	Fw	Pws	Pk	Fs	G	Pdh
EGF	Eigenhof	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fk	Fk
EMV	Elm River	Pb	Va	Fa	Pi	Pi	Pi	Pi	Fs	Pi	Pi
ERX	Eroded Slope Compl	Vt	Va	Pt	Vt	Vt	Pt	Vt	Vt	Vt	Vt
FFR	Fifere	Pbs	Va	Fa	Fa	Fa	Pk	Pk	Fs	Fk	Fk
FFR /xcxx	Fifere	Pbs	Va	Fa	Fa	Fa	Pk	Pk	Fs	Ft	Fk
FFR /xdxx	Fifere	Vb	Va	Fa	Fa	Fa	Pk	Pk	Fs	Pt	Fk
FRS	Ferris	Fbs	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fk	Fk
FRS /xx2x	Ferris	Fps	Va	Faw	Pw	Faw	Pw	Fw	Fsp	Fha	Fk
FRS /xcxx	Ferris	Fs	Va	Faw	Pw	Fw	Ph	Fw	Fs	Fk	Fk
FRS /xxxs	Ferris	Pn	Va	Faw	Pw	Fw	Ph	Fw	Fs	Fk	Fk
FSO	Fresno	Pbs	Va	Faw	Pw	Faw	Pw	Pgk	Fs	Fk	Fk
FTE	Fortier	Ps	Va	Pa	Paw	Pa	Pws	Pi	Ps	Vi	Phi
FTE /xxxs	Fortier	Psn	Va	Pa	Paw	Pa	Pws	Pi	Ps	Vi	Phi
FWK	Froswick	Fsb	Va	Fad	Pd	Fa	Vd	Pk	Pd	Pd	Pd
FWK /xx1x	Froswick	Fsb	Va	Fad	Fad	Fa	Vd	Pk	Pd	Pd	Pd
FWK /1c2x	Froswick	Pb	Va	Fad	Fap	Fa	Vd	Pk	Pd	Pd	Pd
FWK /xc3x	Froswick	Pp	Va	Fap	Pp	Fap	Vd	Pk	Pdp	Pd	Pd
FWK /xx4s	Froswick	Ppn	Va	Pp	Pp	Pp	Vd	Pk	Pdp	Pd	Pd
FWK /xdxx	Froswick	Fbt	Va	Fa	Fad	Fa	Vd	Pk	Pd	Pdp	Pd
FWK /xe2x	Froswick	Pt	Va	Fa	Fdt	Fat	Vd	Pk	Pd	Vt	Pd
GCS	Glencross	Fs	Va	Faw	Pw	Faw	Ph	Fw	Fs	Fhk	Fk
GCS1 /xcxx	Glencross	Fs	Va	Faw	Pw	Faw	Ph	Fw	Fs	Fhk	Fk
GCS /xc1x	Glencross	Fs	Va	Faw	Pw	Faw	Ph	Fw	Fs	Fhk	Fk
GCS /xcxs	Glencross	Pn	Va	Faw	Pw	Faw	Ph	Fw	Fs	Fhk	Fk
GCS /xc2x	Glencross	Fsp	Va	Faw	Pw	Faw	Ph	Fw	Fs	Fhk	Fk
GCS /xxxt	Glencross	Vn	Va	Faw	Pw	Fw	Ph	Fw	Fs	Fhk	Fk
GCS /xx5s	Glencross	Vnp	Va	Vp	Ppw	Vp	Vp	Fw	Vp	Vp	Fk
GDH	Gnadenthal	G	Va	Faw	Pw	Faw	Pw	Fw	G	Fak	Fk

TABLE 13. SUITABILITY RATINGS OF SOILS FOR SELECTED ENGINEERING USES

Map Symbol and Phase		Soil Name	Top Soil	Sand & Gravel	Road Fill	Permanent Bldgs. With Basements	Local Roads and Streets	Sanitary Trench	Landfill Area	Cover Material	Sewage Lagoons	Septic Fields
GDH	/xxxs	Gnadenthal	Pn	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fak	Fk
GDH	/xxxt	Gnadenthal	Vn	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fak	Fk
GRA		Gretna	Ps	Va	Pa	Paw	Pa	Ps	Fw	Psk	G	Vk
GRA	/xxxs	Gretna	Pns	Va	Pa	Paw	Pa	Ps	Fw	Psu	G	Vk
GRA	/xxxu	Gretna	Vn	Va	Pa	Paw	Pa	Ps	Fw	Psu	G	Vk
GRR		Guerra	Ps	Va	Vh	Vh	Pw	Vw	Vh	Pw	Vh	Vh
GRR	/xxxs	Guerra	Psn	Va	Vh	Vh	Pw	Vw	Vh	Pw	Vh	Vh
GRR	/xx3x	Guerra	Pps	Va	Vh	Vh	Pw	Vw	Vh	Ppw	Vh	Vh
GRR	/xx3t	Guerra	Vn	Va	Vh	Vh	Pw	Vw	Vh	Ppw	Vh	Vh
GRR	/xx4t	Guerra	Vn	Va	Vh	Vw	Ppw	Vhw	Vhw	Pwp	Vhp	Vh
GRRp		Guerra	Vw	Va	Vwa	Vhw	Vw	Vhw	Vhw	Vw	Vh	Vhi
GVS		Gervais	Fis	Va	Faw	Piw	Pi	Piw	Pi	Fs	Vi	Phi
GVS	/xcxx	Gervais	Pb	Va	Faw	Piw	Fiw	Piw	Pi	G	Vi	Phi
GYV		Graysville	G	Va	Faw	Pw	Faw	Psw	Fw	G	G	Pdh
GYV	/xxxs	Graysville	Pn	Va	Faw	Pw	Faw	Psw	Fw	G	G	Pdh
HEB		Hebbot	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fk	Fk
HEB	/2c1x	Hebbot	Vb	Va	Fa	Fa	Fa	Fs	G	Fs	Fkt	Fk
HEB	/1d1x	Hebbot	Pbt	Va	Fa	Fat	Fa	Fs	G	Fs	Pt	Fk
HEB	/1e1x	Hebbot	Pbt	Va	Fa	Fat	Fat	Fs	Ft	Fst	Vt	Fkt
HHF		Hochfeld	G	Va	Fa	Fa	Fa	Pkh	Pk	G	Pk	Fh
HHF	/0xxx	Hochfeld	G	Va	Fa	Fa	Fa	Pkh	Pk	G	Pk	Fh
HHF	/2xxx	Hochfeld	Pb	Va	Fa	Fa	Fa	Pkh	Pk	G	Pk	Fh
HHF	/xcxx	Hochfeld	G	Va	Fa	Fa	Fa	Pkh	Pk	G	Pk	Fh
HIN		Hibsin	G	Pa	Pa	Pa	Fa	Ps	Pk	G	Fa	Pd
HND		Horndean	Ps	Va	Fwa	Pwa	Pa	Psh	Fw	Ps	Pk	Fk
HND	/xxxs	Horndean	Pns	Va	Fwa	Pwa	Pa	Psh	Fw	Ps	Pk	Fk
HOS		Horose	Fs	Va	Vh	Vh	Pw	Vhw	Vh	Pw	Fk	Vh
HOS	/xxxs	Horose	Pn	Va	Vh	Vh	Pw	Vhw	Vh	Pw	Fk	Vh
JIS		Jirose	Fbs	Va	Fdw	Pdw	Fw	Vd	Pk	Pd	Pd	Pd
JIS	/xxxs	Jirose	Pn	Va	Fdw	Pdw	Fw	Vd	Pk	Pd	Pd	Pd

TABLE 13. SUITABILITY RATINGS OF SOILS FOR SELECTED ENGINEERING USES

Map Symbol and Phase	Soil Name	Top Soil	Sand & Gravel	Road Fill	Permanent Bldgs. With Basements	Local Roads and Streets	Sanitary Trench	Landfill Area	Cover Material	Sewage Lagoons	Septic Fields
JOD	Jordan	Ps	Va	Fa	Fa	Pa	Fa	Pk	Ps	Pak	Fk
JOD1	Jordan	Fs	Va	Fa	Fa	Pa	Ph	Pk	Ps	Pak	Fk
JST	Jasset	G	Paq	Faw	Pw	Faw	Pkh	Pk	G	Pk	Fh
JYL	Joyale	Fs	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fk	Fhk
JYL /xxxs	Joyale	Pn	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fk	Fhk
JYL /xxxt	Joyale	Vn	Va	Faw	Pw	Faw	Ph	Fw	Fs	Fk	Fhk
KDA	Klidal	Psu	Va	Pad	Paw	Pa	Vd	Fw	Pds	G	Pkd
KDA /xx1s	Klidal	Pnu	Va	Pad	Paw	Pa	Vd	Pk	Pds	G	Pkd
KDA /xexx	Klidal	Ptu	Va	Pad	Paw	Pa	Vd	Pk	Pds	Vt	Pkd
KIS	Kingsley	Pb	Va	Fa	Fa	Fa	Fs	G	Fs	Fk	Fk
KOT	Kronstal	G	Va	Fw	Pw	Fwa	Phk	Pk	G	Pk	Fhk
KOT /0xxx	Kronstal	G	Va	Fw	Pw	Fwa	Phk	Pk	G	Pk	Fhk
KUD	Knudson	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fk	Fk
KUD /xcxx	Knudson	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fkt	Fk
KUD /1c1x	Knudson	Pb	Va	Fa	Fa	Fa	Fs	G	Fs	Fkt	Fk
LAY	Layland	Fb	Va	Pw	Vh	Vw	Vw	Vw	Pw	G	Vh
LAYd	Layland	G	Va	Vah	Vh	Vaw	Vw	Vw	Pw	G	Vh
LAYdp	Layland	G	Va	Vah	Vh	Vaw	Vw	Vw	Pw	G	Vh
LAYdp/0xxx	Layland	G	Va	Vah	Vh	Vaw	Vw	Vw	Pw	G	Vh
LAYp	Layland	G	Va	Vah	Vh	Vaw	Vw	Vw	Vsw	G	Vh
LEI	Levine	Fis	Va	Faw	Piw	Pi	Pi	Pig	Fs	Vi	Pi
LEW	Loewen	Viw	Va	Vw	Vi	Vi	Viw	Vi	Vw	Vi	Vi
LEWp /xxxs	Loewen	Pn	Va	Vw	Vi	Vai	Viw	Vi	Vsw	Vi	Vi
LEWp	Loewen	G	Va	Vw	Vi	Vai	Viw	Vi	Vsw	Vi	Vi
LLT	Lelant	G	Pa	Pw	Pw	Pw	Vw	Vh	Vw	Vhk	Vh
LLT /0xxx	Lelant	G	Paq	Pw	Vh	Pw	Vw	Vh	Pw	Vhk	Vh
LLT /xxxs	Lelant	Pn	Pa	Pw	Vh	Pw	Vw	Vh	Vw	Vhk	Vh
LLTd	Lelant	G	Pa	Pw	Vh	Vwa	Vw	Pw	Pw	Vkh	Vh
LLTdp	Lelant	G	Pa	Pw	Vh	Vwa	Vw	Pw	Pw	Vkh	Vh
LLTdp/xxxs	Lelant	Pn	Paq	Pwa	Vh	Vwa	Vw	Vh	Pw	Vkh	Vh

TABLE 13. SUITABILITY RATINGS OF SOILS FOR SELECTED ENGINEERING USES

Map Symbol and Phase	Soil Name	Top Soil	Sand & Gravel	Road Fill	Permanent Bldgs. With Basements	Local Roads and Streets	Sanitary Landfill Trench	Sanitary Landfill Area	Cover Material	Sewage Lagoons	Septic Fields
LLTp	Lelant	G	Pa	Vw	Vwh	Vwa	Vw	Vwh	Vw	Vhk	Vh
LLTp /0xxx	Lelant	G	Paq	Vw	Vh	Vwa	Vw	Vhw	Vw	Vkh	Vh
LOP	Long Plain	Ps	Pa	Fw	Pw	Fw	Vs	Pk	Fs	Vk	Fhg
LOP /xcxx	Long Plain	Ps	Pa	Fw	Pw	Fw	Vs	Pk	Fs	Vk	Fhg
LOP /xdxx	Long Plain	Ps	Pa	Fw	Pw	Fw	Vs	Pk	Fs	Vk	Fhg
LOP /0xxx	Long Plain	Ps	Paq	Fw	Pw	Fw	Vs	Pk	Fs	Vk	Fhg
LOP /1xxx	Long Plain	Ps	Pa	Fw	Pw	Fw	Vsk	Pk	Fs	Vk	Fhg
LOP /2xxx	Long Plain	Vb	Pa	Fw	Pw	Fw	Vs	Pk	Fs	Vk	Fhg
LOP /0cxx	Long Plain	Ps	Paq	Fw	Pw	Fw	Vs	Pk	Fs	Vk	Fhg
LOP /1cxx	Long Plain	Psb	Pa	Fw	Pw	Fw	Vs	Pk	Fs	Vk	Fhg
LOP1	Long Plain	Psb	Pa	Fw	Pw	Fw	Vs	Pk	Fs	Vk	Fhg
LOP1 /xcxx	Long Plain	Psb	Pa	Fw	Pw	Fw	Vs	Pk	Fs	Vk	Fhg
LOP1 /xdxx	Long Plain	Psb	Pa	Fw	Pw	Fw	Vs	Pk	Fs	Vk	Fhg
LOP1 /0xxx	Long Plain	Psb	Paq	Fw	Pw	Fw	Vs	Pk	Fs	Vk	Fhg
LOP1 /1xxx	Long Plain	Psb	Pa	Fw	Pw	Fw	Vs	Pk	Fs	Vk	Fhg
LOP1 /0xxx	Long Plain	Psb	Paq	Fw	Pw	Fw	Vs	Pk	Fs	Vk	Fhg
LOP1 /1cxx	Long Plain	Vb	Pa	Fw	Pw	Fw	Vs	Pk	Fs	Vk	Fhg
LRY	Leary	Ps	G	G	G	G	Vsk	Vk	Vs	Vka	Gg
LRY /1cxx	Leary	Ps	G	G	G	G	Vsk	Vk	Va	Vka	Gg
LRY /xd1x	Leary	Pst	G	G	G	G	Vsk	Vk	Vs	Vka	Gg
LRY /2d2x	Leary	Pst	G	G	Fp	G	Vsk	Vk	Vs	Vka	Gg
LSL	La Salle	Pb	Va	Fa	Pi	Fia	Pi	Pi	Fs	Pvi	Pi
LSL /xcxx	La Salle	Pb	Va	Fa	Pi	Fia	Pi	Pi	Fs	Pi	Pi
MFI /xx3x	Mansfield	Pps	G	Fw	Ppw	Fw	Vs	Vk	Vp	Vka	Fhg
MHC	Marsh Complex	Vw	Va	Vw	Vw	Vw	Vw	Vw	Vw	Vh	Vw
MOW	Mowbray	Pb	Va	Fa	Fa	Fa	Fis	Fi	Fs	Fa	Fk
MRH	Marringhurst	Psb	G	G	G	G	Vsk	Vk	Vs	Vk	Gg
MRS	Morris	Ps	Va	Pa	Paw	Pa	Psw	Fw	Ps	G	Vk
MRS /xxxs	Morris	Pns	Va	Pa	Paw	Pa	Psw	Fw	Ps	G	Vk
MXS	Manitou	Fs	Va	Pa	Fa	Fa	Fks	G	Ps	Fk	Fk

TABLE 13. SUITABILITY RATINGS OF SOILS FOR SELECTED ENGINEERING USES

Map Symbol and Phase	Soil Name	Top Soil	Sand & Gravel	Road Fill	Permanent Bldgs. With Basements	Local Roads and Streets	Sanitary Trench	Landfill Area	Cover Material	Sewage Lagoons	Septic Fields
MYT	Myrtle	Ps	Va	Pal	Pa	Pa	Ps	G	Ps	G	Pk
MYT /0xxx	Myrtle	Ps	Va	Pal	Pa	Pa	Ps	G	Ps	G	Pk
NBG	Neuenberg	G	Paq	Faw	Pw	Faw	Pkw	Pk	G	Pk	Fh
NBG /xxxs	Neuenberg	Pn	Paq	Faw	Pw	Faw	Pkw	Pk	G	Pk	Fh
NBG /xxxt	Neuenberg	Vn	Paq	Faw	Pw	Faw	Pkw	Pk	G	Pk	Fh
NKK	Nikkel	Fs	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fk	Fhk
NKK /xx1x	Nikkel	Fs	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fk	Fhk
NKK /xx1s	Nikkel	Pn	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fk	Fhk
NKK /xxxs	Nikkel	Pn	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fk	Fhk
NOW	Nowell	Fs	Va	Faw	Pw	Faw	Ph	Fw	Fs	Fk	Fkh
NTO	Nanton	Fb	Va	Faw	Pw	Faw	Ph	Fw	Fs	Fk	Fhk
NTO /xx1s	Nanton	Pn	Va	Faw	Pw	Fwa	Ph	Fw	Fs	Fk	Fhk
NUH	Neuhorst	Fs	Va	Faw	Pw	Fwa	Pw	Fw	Fs	Fk	Fkh
NUH /xxxs	Neuhorst	Pn	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fk	Fhk
NWN	Newton Siding	Fs	Va	Faw	Pw	Faw	Pw	Fw	Fs	Pk	Fhk
NWN /xxxs	Newton Siding	Pn	Va	Faw	Pw	Faw	Pw	Fw	Fs	Pk	Fhk
NWN /xxxt	Newton Siding	Vn	Va	Faw	Pw	Faw	Pw	Fw	Fs	Pk	Fhk
OAY	Oakley	Fs	Va	Fad	Fd	Fa	Pd	Pk	Pd	Pd	Pd
OAY /xcxx	Oakley	Fs	Va	Fad	Pd	Fad	Pd	G	Pd	Pd	Pd
OAY /xc1x	Oakley	Fs	Va	Fad	Fd	Fa	Pd	Pk	Pd	Pd	Pd
OAY /xc4x	Oakley	Pp	Va	Pap	Pp	Pp	Pdp	Pk	Pdp	Pdp	Pd
OAY /1d1x	Oakley	Pb	Va	Fad	Fd	Fa	Pd	Pk	Pd	Vt	Pd
OBO	Osborne	Ps	Va	Paw	Vw	Paw	Vw	Pw	Psw	G	Vhk
OBO /xxxs	Osborne	Psn	Va	Pwa	Vw	Paw	Vw	Pw	Psw	G	Vhk
OBOd /xxxt	Osborne	Vn	Va	Paw	Vw	Paw	Vw	Pw	Psw	G	Vhk
OBOd	Osborne	Ps	Va	Va	Vw	Va	Vw	Vw	Psw	G	Vhk
OBOp	Osborne	Vw	Va	Vwa	Vw	Va	Vw	Vw	Vsw	G	Vhk
OBOdp	Osborne	Ps	Va	Va	Vw	Va	Vw	Vw	Psw	G	Vhk
OWK	Osterwick	G	Va	Pw	Vw	Pw	Vw	Pkw	Pw	Pkh	Vh
OWKd	Osterwick	G	Va	Ph	Vw	Pw	Vw	Pkw	Pw	Pkh	Vh

TABLE 13. SUITABILITY RATINGS OF SOILS FOR SELECTED ENGINEERING USES

Map Symbol and Phase	Soil Name	Top Soil	Sand & Gravel	Road Fill	Permanent Bldgs. With Basements	Local Roads and Streets	Sanitary Trench	Landfill Area	Cover Material	Sewage Lagoons	Septic Fields
OWKdp	Osterwick	G	Va	Ph	Vw	Pw	Vw	Pkw	Pw	Pkh	Vh
OWKp	Osterwick	Vw	Va	Vw	Vw	Vwa	Vw	Pkw	Pw	Pkh	Vh
PBI	Pembina	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fk	Fk
PBI /xcxx	Pembina	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fkt	Fk
PBI /lclx	Pembina	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fkt	Fk
PBI /xdxx	Pembina	Fst	Va	Fa	Fa	Fa	Fs	G	Fs	Pt	Fk
PBI /ldlx	Pembina	Fst	Va	Fa	Fa	Fa	Fs	G	Fs	Pt	Fk
PBI /xelx	Pembina	Pt	Va	Fa	Fat	Fat	Fs	Ft	Fst	Vt	Fkt
PBI /lelx	Pembina	Pt	Va	Fa	Fat	Fat	Fs	Ft	Fst	Vt	Fkt
PER	Perillo	G	Va	Vaw	Vaw	Vaw	Vsw	Vw	Vsw	Vah	Vh
PERd	Perillo	G	Va	Vah	Vaw	Vaw	Vsw	Vw	Vsw	Vah	Vh
PERl	Perillo	Vw	Va	Vaw	Vaw	Vaw	Vsw	Vw	Vsw	Vah	Vh
PGK	Pigeon Lake	Fs	Va	Faw	Piw	Pi	Piw	Pi	Fs	Vi	Phi
PME	Plum Coulee	Ps	Va	Pa	Pwa	Pa	Pws	Fw	Ps	Fah	Phk
PMEl	Plum Coulee	Fs	Va	Pa	Paw	Pa	Ps	Fw	Ps	G	Phk
PME /xxxs	Plum Coulee	Psn	Va	Pa	Pwa	Pa	Phs	Fw	Ps	Fah	Phk
POU	Pouchal	Fs	Va	Vh	Vh	Pw	Vhw	Vh	Pw	Fa	Vh
POU /xcxx	Pouchal	Pb	Va	Vh	Vh	Pw	Vw	Vhw	Pw	Vh	Vh
PYR	Poyser	Pb	Va	Fa	Fa	Fa	Fs	G	Fs	Vh	Fk
PYR /xdlx	Poyser	Vbt	Va	Fa	Fa	Fa	Fs	G	Fs	Pt	Fk
RBK	Rosebank	G	Va	Faw	Pwa	Fw	Pw	Fw	Fs	Pk	Phd
RBKl	Rosebank	G	Va	Faw	Pwa	Fw	Pw	Fw	Fs	Pk	Phd
RFD	Reinfeld	G	Va	Fa	Fa	Fa	G	G	G	Fk	Fk
RFD /lxxx	Reinfeld	Fb	Va	Fa	Fa	Fa	G	G	G	Fk	Fk
RGD	Rignold	G	Va	Fa	Pwa	Faw	Ps	Fw	G	G	Pdh
RIV	Red River	Ps	Va	Pa	Paw	Pa	Pws	Fw	Ps	G	Vk
RIV /xxxs	Red River	Psn	Va	Pa	Paw	Pa	Pws	Fw	Ps	G	Vk
RLD	Reinland	G	Va	Fw	Pw	Fw	Pwk	Pk	G	Pk	Fh
RLD /xcxx	Reinland	G	Va	Fw	Pw	Fw	Pwk	Pk	G	Pk	Fh
RLD /xxxs	Reinland	Pn	Va	Fw	Pw	Fw	Pwk	Pk	G	Pk	Fh

TABLE 13. SUITABILITY RATINGS OF SOILS FOR SELECTED ENGINEERING USES

Map Symbol and Phase	Soil Name	Top Soil	Sand & Gravel	Road Fill	Permanent Bldgs. With Basements	Local Roads and Streets	Sanitary Trench	Landfill Area	Cover Material	Sewage Lagoons	Septic Fields
RLD /1xxx	Reinland	Fb	Va	Fw	Pw	Fw	Pwk	Pk	G	Pk	Ph
RSG	Rosengart	G	Va	Fa	Fa	Fa	Pk	Pk	G	Pk	Gg
RSI	Roseisle	Fs	Va	Fa	Fa	Fa	Fs	Gg	Fs	Fkg	Fkg
RSI /xcxx	Roseisle	Fs	Va	Fa	Fa	Fa	Fs	Gg	Fs	Ftg	Fkg
RSI /xx1x	Roseisle	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fk	Fkg
RSI /xc1x	Roseisle	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fkt	Fkg
RSI /xc2x	Roseisle	Fps	Va	Fa	Fap	Fa	Fsp	G	Fsp	Fkt	Fkg
RSI /xd1x	Roseisle	Fts	Va	Fa	Fa	Fa	Fsp	G	Fs	Pt	Fkg
RSI /xx3x	Roseisle	Pp	Va	Fap	Pp	Fap	Pp	G	Pp	Fkp	Fkg
RSI /xx5x	Roseisle	Vp	Va	Vp	Vp	Vp	Vp	G	Vp	Vp	Fkg
RSI /1e5x	Roseisle	Vp	Va	Vp	Vp	Vp	Vp	Pt	Vp	Vp	Pkg
RWL	Rathwell	Fs	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fk	Fhk
SCK	Stockton	Ps	Fa	G	G	G	Vsk	Vk	Vs	Vk	Gg
SCK /xcxx	Stockton	Ps	Fa	G	G	G	Vsk	Vk	Vs	Vk	Gg
SCY	Scanterbury	Ps	Va	Pa	Paw	Pa	Pws	Fw	Ps	G	Pk
SKL	Skelding	Vb	G	G	G	G	Vk	Vk	Vs	Vk	Gg
SKL /xcxx	Skelding	Vb	G	G	G	G	Vk	Vk	Vs	Vk	Gg
SKL /xdxx	Skelding	Vb	G	G	Ft	Ft	Vk	Vk	Vs	Vkt	Ft
SKL /xexx	Skelding	Vb	G	G	Ft	Ft	Vk	Vk	Vs	Vkt	Fa
SKL /xfxx	Skelding	Vbt	G	Ft	Pt	Pt	Vk	Vk	Vs	Vt	Ptg
SKL /xgxx	Skelding	Vbt	G	Pt	Vt	Vt	Vk	Vk	Vs	Vkt	Vtg
SKL /xhxx	Skelding	Vbt	G	Vt	Vt	Vt	Vk	Vk	Vs	Vkt	Vtg
SKLa /xexx	Skelding	Vb	G	G	Ft	Ft	Vk	Vk	Vs	Vkt	Ftg
SKLa /xfxx	Skelding	Vbt	G	Ft	Pt	Pt	Vk	Vk	Vs	Vkt	Ptg
SKLa /xhxx	Skelding	Vbt	G	Vt	Vt	Vt	Vkt	Vk	Vst	Vkt	Vtg
SKL1 /xcxx	Skelding	Vb	G	G	G	G	Vk	Vk	Vs	Vk	Gg
SKL1 /xdxx	Skelding	Vb	G	G	G	G	Vk	Vk	Vs	Vk	Gg
SKL1 /xexx	Skelding	Vb	G	G	Ft	Ft	Vk	Vk	Vs	Vkt	Ftg
SKL1a/xexx	Skelding	Vb	G	G	Ft	Ft	Vk	Vk	Vs	Vkt	Ftg
SKL1 /xgxx	Skelding	Vbt	G	Pt	Vt	Vt	Vk	Vk	Vst	Vkt	Vtg

TABLE 13. SUITABILITY RATINGS OF SOILS FOR SELECTED ENGINEERING USES

Map Symbol and Phase	Soil Name	Top Soil	Sand & Gravel	Road Fill	Permanent Bldgs. With Basements	Local Roads and Streets	Sanitary Trench	Landfill Area	Cover Material	Sewage Lagoons	Septic Fields
SKL1a/xgxx	Skelding	Vbt	G	Pt	Vt	Vt	Vk	Vk	Vst	Vkt	Vtg
SKL1 /xfxx	Skelding	Vbt	G	Ft	Pt	Pt	Vk	Vk	Vst	Vkt	Ptg
SQR	Squirrel Creek	Fb	Va	Faw	Pwa	Pf	Vh	Ph	G	G	Vk
SQR /xxxs	Squirrel Creek	Pn	Va	Faw	Pwa	Pf	Vh	Ph	G	G	Vk
SQR /xxxt	Squirrel Creek	Vn	Va	Faw	Pwa	Pf	Vh	Ph	G	G	Vk
SUE	St.Claude	Fb	Pa	Faw	Pw	Pf	Vh	Phk	G	Vk	Ph
SUE /xxxs	St.Claude	Pn	Pa	Faw	Pw	Pf	Vh	Phk	G	Vk	Ph
SUE /xxxu	St.Claude	Vn	Pa	Faw	Pw	Pf	Vh	Phk	G	Vk	Ph
SUE /0xxx	St.Claude	Fb	Paq	Faw	Pw	Pf	Vh	Phk	G	Vk	Ph
SUE1	St.Claude	Fb	Faq	Faw	Pw	Pf	Vh	Phk	G	Vk	Ph
SXG	Stallar	Pb	Va	Vd	Pd	Fda	Vd	Pdk	Vd	Vd	Vd
SXG /xc4x	Stallar	Pp	Va	Vd	Pd	Fa	Vd	Pdk	Vd	Vd	Vd
SXG /xdxx	Stallar	Pb	Va	Vd	Pd	Fda	Vd	Pdk	Vd	Vd	Vd
SXG /xd1x	Stallar	Pb	Va	Vd	Pd	Fda	Vd	Pdk	Vd	Vd	Vd
SXG /xe4x	Stallar	Pbp	Va	Vd	Pdp	Pp	Vd	Pdk	Vd	Vd	Vd
SXG /1fxx	Stallar	Vt	Va	Vd	Pdt	Pt	Vd	Pdk	Vd	Vdt	Vd
TDW	Tredwell	Pb	Va	Vh	Vw	Vw	Vw	Vw	Pw	Vh	Vh
TLI	Tellier	Fs	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fk	Fk
TNT /1d1x	Trinton	Pbt	Faq	G	G	G	Vsk	Vk	Vg	Vk	Gg
ULH	Ullrich	Fs	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fk	Fhk
ULH /xx1x	Ullrich	Fs	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fk	Fhk
ULH /xc2x	Ullrich	Fps	Va	Faw	Pw	Faw	Phw	Fw	Fsp	Fkt	Fhk
VDL	Vandal	Fb	Fq	G	G	G	Vsk	Vk	Vs	Vka	Gg
VDL /xc1x	Vandal	Fb	Fq	G	G	G	Vsk	Vk	Vs	Vka	Gg
VDL /1c1x	Vandal	Pb	Faq	G	G	G	Vsk	Vk	Vs	Vka	Gg
VTL	Vartel	Fb	Faq	Fw	Pw	Fw	Vsk	Vk	Vs	Vka	Fhg
WIK	Winkler	Ps	Va	Pal	Pa	Pa	Ps	G	Ps	G	Pk
WIK /xcxx	Winkler	Ps	Va	Pal	Pa	Pa	Ps	G	Ps	Ft	Pk
WIK /xdxx	Winkler	Ps	Va	Pal	Pa	Pa	Ps	G	Ps	Pt	Pk
WIK2	Winkler	Ps	Va	Pal	Pa	Pa	Ps	G	Ps	G	Pk

TABLE 13. SUITABILITY RATINGS OF SOILS FOR SELECTED ENGINEERING USES

Map Symbol and Phase	Soil Name	Top Soil	Sand & Gravel	Road Fill	Permanent Bldgs. With Basements	Local Roads and Streets	Sanitary Trench	Landfill Area	Cover Material	Sewage Lagoons	Septic Fields
WIK2 /xexx	Winkler	Pst	Va	Pal	Pa	Pa	Ps	Ft	Ps	Vt	Pk
WIK2 /xfxx	Winkler	Vt	Va	Pal	Pat	Pat	Ps	Pt	Pst	Vt	Pkt
WOR /1c1x	Worden	Vb	Va	Fa	Fa	Fa	Fs	G	Fs	Fkt	Fk
WWB	Willowbend	Vw	Va	Pw	Vi	Vi	Viw	Vi	Vw	Vi	Vi
WWC	Willowcrest	Ps	Pa	Fw	Pw	Fw	Pkw	Pk	Fs	Vk	Fhg
WWC /xcxx	Willowcrest	Ps	Pa	Fw	Pw	Fw	Pkw	Pk	Fs	Vk	Fhg
WWC /1xxx	Willowcrest	Ps	Pa	Fw	Pw	Fw	Pkw	Pk	Fs	Vk	Fhg
WWC /2xxx	Willowcrest	Pbs	Pa	Fw	Pw	Fw	Pkw	Pk	Fs	Vk	Fhg
WWC /0xxx	Willowcrest	Ps	Paq	Fw	Pw	Fw	Pkw	Pk	Fs	Vk	Fhg
WWC /1cxx	Willowcrest	Ps	Pa	Fw	Pw	Fw	Pkw	Pk	Fs	Vk	Fhg
WWC /2cxx	Willowcrest	Vb	Pa	Fw	Pw	Fw	Pkw	Pk	Fs	Vk	Fhg
WWC1	Willowcrest	Ps	Faq	Fw	Pw	Fw	Pkw	Pk	Fs	Vk	Fhg
XVI	Xavier	G	Va	Va	Vaw	Vaw	Vsw	Vw	Vsw	Vah	Vh
YTK /xx2t	Yustak	Vn	Pah	Pw	Vw	Pw	Vsh	Vh	Vdw	Vk	Vh
ZIM	Zinman	Ps	Va	Pal	Pws	Pa	Phs	Fw	Ps	G	Vk
ZIM /xxxs	Zinman	Psn	Va	Pal	Pwa	Pa	Phs	Fw	Ps	G	Vk
ZPI	Zaplin	Fb	Va	Faw	Pw	Faw	Phw	Fw	Fs	Fk	Fkh
ZPI /xcxx	Zaplin	Fb	Va	Faw	Pw	Faw	Phw	Fw	Fs	Fkt	Fkh
ZPI /xexx	Zaplin	Pt	Va	Faw	Pwt	Faw	Phw	Fwt	Fst	Vt	Fkt

TABLE 14. SUITABILITY RATINGS OF SOILS FOR RECREATIONAL USES

Map Symbol and Phase	Soil Name	Play Ground	Picnic Area	Camp Area	Path And Trails	Permanent Bldgs. Without Basements
ARN	Aronet	Vs	Pm	Fs	G	G
ARN /xcxx	Aronet	Vs	Pm	Fs	G	G
ARN /xdxx	Aronet	Vs	Pm	Fs	G	G
ASS	Almasippi	Fsw	Fsw	Fsw	Fw	Fw
ASS /1xxx	Almasippi	Fsw	Fsw	Fsw	Fw	Fw
ASS /0xxx	Almasippi	Fsw	Fsw	Fsw	Fw	Fw
ASS /xcxx	Almasippi	Fst	Fsw	Fsw	Fw	Fw
ASS /1cxx	Almasippi	Fst	Fsw	Fsw	Fw	Fw
ASS /xxxs	Almasippi	Pnw	Pnw	Fsw	Fw	Fw
ASS1	Almasippi	Fsw	Fsw	Fsw	Fw	Fw
ASZ	Agassiz	Pms	Pm	Fs	G	G
ASZ /xcxx	Agassiz	Vs	Pm	Fs	G	G
ASZ /xc2x	Agassiz	Vs	Pm	Fs	G	G
ATN	Altamont	Fks	Fs	Fs	Fs	Fa
ATN /xcxx	Altamont	Fst	Fs	Fs	Fs	Fa
ATN /xc1x	Altamont	Fst	Fs	Fs	Fs	Fa
ATN /1c2x	Altamont	Fst	Fs	Fs	Fs	Fap
BEO	Benton	Ps	Ps	Ps	Ps	Pa
BEO /xc1x	Benton	Ps	Ps	Ps	Ps	Pa
BEO /xc2x	Benton	Ps	Ps	Ps	Ps	Pa
BEO /xc4x	Benton	Psp	Pst	Psp	Psp	Psp
BEO /xdxx	Benton	Pst	Ps	Ps	Ps	Pa
BEO /xd1x	Benton	Pst	Ps	Ps	Ps	Pa
BIP	Bishop	Pws	Ps	Ps	Ps	Pa
BIP /xxxs	Bishop	Pws	Ps	Ps	Ps	Pa
BKA	Birkenhead	Vs	Pm	Fs	G	G
BKA /xcxx	Birkenhead	Vs	Pm	Fs	G	G
BKA /xc2x	Birkenhead	Vs	Pm	Fs	G	G
BKA /xdxx	Birkenhead	Pt	Pm	Fs	G	G
BKR	Basker	Pi	Vwi	Vwi	Pw	Vh
BMG	Blumengart	Psw	Psw	Psw	Ps	Paw
BMG /xxxs	Blumengart	Psw	Psw	Psw	Ps	Paw
BMG /xxxt	Blumengart	Psw	Psw	Psw	Ps	Paw
BNF	Blumenfeld	Vw	Vw	Pw	Pw	Vh
BNF /xxxs	Blumenfeld	Vw	Vw	Pw	Pw	Vhn
BNF /xxxt	Blumenfeld	Vwn	Vw	Pwn	Pw	Vhn
BNF /xxxu	Blumenfeld	Vw	Vwn	Pwn	Pw	Vhn
BNFd /xxxs	Blumenfeld	Vw	Vw	Pw	Pw	Vhn
BNFd	Blumenfeld	Vw	Vw	Pw	Pw	Vhn
BNFp	Blumenfeld	Vsw	Vsw	Vsw	Vsw	Pwh

TABLE 14. SUITABILITY RATINGS OF SOILS FOR RECREATIONAL USES

Map Symbol and Phase	Soil Name	Play Ground	Picnic Area	Camp Area	Path And Trails	Permanent Bldgs. Without Basements
BNI	Brundis	Ps	Ps	Ps	Ps	Pa
BNI /xdxx	Brundis	Pst	Ps	Ps	Ps	Pa
BUM	Blumenort	Vw	Vw	Vw	Pw	Vh
BUM /xxxs	Blumenort	Vw	Vw	Vw	Pw	Vh
BUM /xxxt	Blumenort	Vwn	Vwn	Vwn	Pww	Vh
BUMp	Blumenort	Vsw	Vsw	Vsw	Vs	Vh
CAV	Carvey	Pw	Pw	Vw	Pw	Pw
CAVp	Carvey	Vws	Vws	Vws	Vs	Vw
CTZ	Chortitz	Pw	Pw	Pi	Fis	Pi
CTZ /xxxs	Chortitz	Pw	Pw	Pi	Fw	Pi
CXT	Capell	Fsw	Fsw	Fsw	Fsw	Faw
CXT /xx1x	Capell	Fsw	Fsw	Fsw	Fsw	Faw
CYN	Croyon	Fs	Fs	Fs	Fs	G
CYN /xcxx	Croyon	Fst	Fs	Fs	Fs	G
CZK	Cazlake	Vw	Vw	Vw	Pw	Vh
CZK /xxxs	Cazlake	Vw	Vw	Vw	Pw	Vh
DGF	Darlingford	Fs	Fs	Fs	Fs	Fa
DGF /xx1x	Darlingford	Fs	Fs	Fs	Fs	Fa
DGF /1x1x	Darlingford	Fs	Fs	Fs	Fs	Fa
DGF /xx2x	Darlingford	Fsp	Fsp	Fsp	Fs	Fap
DGF /xc1x	Darlingford	Fst	Fs	Fs	Fs	Fa
DGF /2cxx	Darlingford	Fst	Fs	Fs	Fs	Fa
DGF /2c1x	Darlingford	Fst	Fs	Fs	Fs	Fa
DGS	Dugas	Ps	Ps	Ps	Ps	Pa
DGS /xxxs	Dugas	Psn	Ps	Ps	Ps	Pan
DGS /xxxt	Dugas	Psn	Psn	Psn	Ps	Pan
DHO	Deadhorse	Ps	Ps	Ps	Ps	Pa
DHO /xxxs	Deadhorse	Psn	Ps	Ps	Ps	Pan
DHO1	Deadhorse	Fs	Ps	Ps	Ps	Pa
DNH	Denham	G	G	G	G	Fa
DNH /xcxx	Denham	Ft	G	G	G	Fa
DNH /Oxxx	Denham	G	G	G	G	Fa
DOB	Dobbin	Fm	Fm	Fs	G	G
DXM	Druxman	Fsw	Fsw	Fsw	Fsw	Fwa
DZW	Dezwood	Fs	Fs	Fs	Fs	Fa
DZW /xx1x	Dezwood	Fs	Fs	Fs	Fs	Fa
DZW /xcxx	Dezwood	Fts	Fs	Fs	Fs	Fa
DZW /1cxx	Dezwood	Fst	Fs	Fs	Fs	Fa
DZW /xc1x	Dezwood	Fts	Fs	Fs	Fs	Fa
DZW /1c1x	Dezwood	Fts	Fs	Fs	Fs	Fa

TABLE 14. SUITABILITY RATINGS OF SOILS FOR RECREATIONAL USES

Map Symbol and Phase	Soil Name	Play Ground	Picnic Area	Camp Area	Path And Trails	Permanent Bldgs. Without Basements
DZW /xc2x	Dezwood	Fts	Fs	Fsp	Fs	Fa
DZW /xdxx	Dezwood	Pt	Fs	Fs	Fs	Fa
DZW /1dxx	Dezwood	Pt	Fs	Fs	Fs	Fa
DZW /xd1x	Dezwood	Pt	Fs	Fs	Fs	Fa
DZW /xd2x	Dezwood	Pt	Fs	Fsp	Fs	Fap
DZW /xexx	Dezwood	Vt	Fst	Fts	Fs	Fta
EBG	Edenburg	Fs	Fs	Fs	Fs	Fa
EDK	Edkins	Vw	Vw	Vw	Pw	Pw
EDK /xxxs	Edkins	Vw	Vw	Vw	Pw	Pw
EDKd	Edkins	Vs	Vsw	Vsw	Vs	Va
EDKdp	Edkins	Vs	Vsw	Vsw	Vs	Va
EEK	Elm Creek	Fsw	Fsw	Fsw	Fw	Fw
EGF	Eigenhof	Fs	Fs	Fs	Fs	Fa
EMV	Elm River	Fis	Fis	Pi	Fis	Pi
ERX	Eroded Slope Compl	Vt	Vt	Vt	Pt	Vt
FFR	Fifere	Fs	Fs	Fs	Fs	Fa
FFR /xcxx	Fifere	Fst	Fs	Fs	Fs	Fa
FFR /xdxx	Fifere	Pt	Fs	Fs	Fs	Fa
FRS	Ferris	Fw	Fws	Fws	Fws	Fws
FRS /xx2x	Ferris	Fwp	Fws	Fwp	Fws	Faw
FRS /xcxx	Ferris	Fsw	Fsw	Fsw	Fsw	Faw
FRS /xxxs	Ferris	Fsw	Fsw	Fsw	Fsw	Faw
FSO	Fresno	Fw	Fws	Fws	Fws	Fwa
FTE	Fortier	Ps	Ps	Ps	Ps	Pa
FTE /xxxs	Fortier	Ps	Ps	Ps	Ps	Pa
FWK	Froswick	Fs	Fs	Fs	Fs	Fd
FWK /xx1x	Froswick	Fst	Fs	Fs	Fs	Fd
FWK /1c2x	Froswick	Fst	Fs	Fsp	Fs	Fd
FWK /xc3x	Froswick	Pp	Fsp	Pp	Fsp	Fdp
FWK /xx4s	Froswick	Pp	Pp	Pp	Pp	Pdp
FWK /xdxx	Froswick	Ppt	Fs	Fs	Fs	Fd
FWK /xe2x	Froswick	Vt	Fst	Fst	Fs	Fde
GCS	Glencross	Fsw	Fsw	Fsw	Fsw	Faw
GCS1 /xcxx	Glencross	Fsw	Fsw	Fsw	Fsw	Faw
GCS /xc1x	Glencross	Fsw	Fsw	Fsw	Fsw	Faw
GCS /xcxs	Glencross	Fsw	Fsw	Fsw	Fsw	Faw
GCS /xc2x	Glencross	Fsp	Fsw	Fsw	Fsw	Faw
GCS /xxxt	Glencross	Fwn	Fwn	Fwn	Fsw	Faw
GCS /xx5s	Glencross	Vp	Vp	Vp	Vp	Vp
GDH	Gnadenthal	Fw	Fw	Fw	Fw	Fw

TABLE 14. SUITABILITY RATINGS OF SOILS FOR RECREATIONAL USES

Map Symbol and Phase	Soil Name	Play Ground	Picnic Area	Camp Area	Path And Trails	Permanent Bldgs. Without Basements
GDH /xxxs	Gnadenthal	Pnw	Fw	Fw	Fw	Fw
GDH /xxxt	Gnadenthal	Pwn	Pnw	Pnw	Fw	Fw
GRA	Gretna	Pws	Psk	Psk	Ps	Pa
GRA /xxxs	Gretna	Pws	Psk	Psk	Ps	Pa
GRA /xxxu	Gretna	Pws	Vn	Vn	Ps	Pa
GRR	Guerra	Vw	Vw	Vw	Pw	Vh
GRR /xxxs	Guerra	Vw	Vw	Vw	Pw	Vh
GRR /xx3x	Guerra	Vw	Vw	Vw	Pw	Vh
GRR /xx3t	Guerra	Vw	Vw	Vw	Pw	Vh
GRR /xx4t	Guerra	Vw	Vw	Vw	Ppw	Vh
GRRp	Guerra	Vws	Vws	Vws	Vs	Vaw
GVS	Gervais	Fsw	Fsw	Fsw	Fsw	Pi
GVS /xcxx	Gervais	Fst	Fsw	Fsw	Fsw	Pi
GYV	Graysville	Fw	Fw	Fw	Fw	Fw
GYV /xxxs	Graysville	Pnw	Fw	Fw	Fw	Fw
HEB	Hebbot	Fs	Fs	Fs	Fs	Fa
HEB /2c1x	Hebbot	Fst	Fs	Fs	Fs	Fa
HEB /1d1x	Hebbot	Pt	Fs	Fs	Fs	Fa
HEB /1e1x	Hebbot	Vt	Fst	Fst	Fs	Fat
HHF	Hochfeld	Fs	G	G	G	Fa
HHF /0xxx	Hochfeld	Fs	G	G	G	Fa
HHF /2xxx	Hochfeld	Fs	G	G	G	Fa
HHF /xcxx	Hochfeld	Fs	G	G	G	Fa
HIN	Hibsin	Fs	Fs	Fs	G	Fa
HND	Horndean	Ps	Ps	Ps	Ps	Pa
HND /xxxs	Horndean	Ps	Ps	Ps	Ps	Pa
HOS	Horose	Vw	Vw	Vw	Pw	Pw
HOS /xxxs	Horose	Vw	Vw	Vw	Pw	Pw
JIS	Jirose	Fd	Fws	Fws	Fws	Fwd
JIS /xxxs	Jirose	Fd	Fws	Fws	Fws	Fwd
JOD	Jordan	Ps	Fs	Fs	Fs	Fa
JOD1	Jordan	Ps	Fs	Fs	Fs	Fa
JST	Jasset	Fw	Fw	Fw	G	Fa
JYL	Joyale	Fsw	Fsw	Fsw	Fsw	Faw
JYL /xxxs	Joyale	Pwn	Pwn	Fsw	Fsw	Faw
JYL /xxxt	Joyale	Pwn	Psk	Pnw	Fsw	Fa
KDA	Klidal	Psw	Psk	Psw	Ps	Pa
KDA /xx1s	Klidal	Psw	Psk	Psw	Ps	Pa
KDA /xexx	Klidal	Vt	Psk	Psw	Ps	Pa
KIS	Kingsley	Fs	Fs	Fs	Fs	Fa

TABLE 14. SUITABILITY RATINGS OF SOILS FOR RECREATIONAL USES

Map Symbol and Phase	Soil Name	Play Ground	Picnic Area	Camp Area	Path And Trails	Permanent Bldgs. Without Basements
KOT	Kronstal	Fw	Fw	Fw	G	Fa
KOT /0xxx	Kronstal	Fw	Fw	Fw	G	Fa
KUD	Knudson	Fs	Fs	Fs	Fs	Fa
KUD /xcxx	Knudson	Fst	Fs	Fs	Fs	Fa
KUD /1c1x	Knudson	Fst	Fs	Fs	Fs	Fa
LAY	Layland	Vw	Vw	Vw	Pw	Pw
LAYd	Layland	Vs	Vs	Vs	Vs	Vha
LAYdp	Layland	Vs	Vs	Vs	Vs	Vha
LAYdp/0xxx	Layland	Vs	Vs	Vs	Vs	Vha
LAYp	Layland	Vs	Vsw	Vsw	Vs	Vha
LEI	Levine	Fis	Fis	Pi	Fsw	Pi
LEW	Loewen	Vi	Vi	Vi	Vi	Vi
LEWp /xxxs	Loewen	Vis	Vis	Vis	Vis	Via
LEWp	Loewen	Vis	Vis	Vis	Vis	Via
LLT	Lelant	Vw	Vw	Vw	Pw	Pw
LLT /0xxx	Lelant	Vw	Vw	Vw	Pw	Pw
LLT /xxxs	Lelant	Vw	Vw	Vw	Pw	Pw
LLTd	Lelant	Vs	Vs	Vws	Vs	Pw
LLTdp	Lelant	Vs	Vs	Vws	Vs	Pw
LLTdp/xxxs	Lelant	Vs	Vws	Vws	Vs	Va
LLTp	Lelant	Vsw	Vws	Vws	Vws	Va
LLTp /0xxx	Lelant	Vsw	Vws	Vws	Vs	Va
LOP	Long Plain	Fsw	Fsw	Fsw	G	Fw
LOP /xcxx	Long Plain	Ftw	Fsw	Fsw	G	Fw
LOP /xdxx	Long Plain	Pt	Fsw	Fsw	G	Fw
LOP /0xxx	Long Plain	Vs	Pm	Fsw	G	Fw
LOP /1xxx	Long Plain	Fsw	Fsw	Fsw	G	Fw
LOP /2xxx	Long Plain	Vs	Fsw	Fsw	G	Fw
LOP /0cxx	Long Plain	Vs	Pm	Fsw	G	Fw
LOP /1cxx	Long Plain	Fsw	Fsw	Fsw	G	Fw
LOP1	Long Plain	Fs	Fsw	Fsw	G	Fw
LOP1 /xcxx	Long Plain	Fst	Fsw	Fsw	G	Fw
LOP1 /xdxx	Long Plain	Pt	Fsw	Fsw	G	Fw
LOP1 /0xxx	Long Plain	Vs	Pm	Fsw	G	Fw
LOP1 /1xxx	Long Plain	Vs	Fsw	Fsw	G	Fw
LOP1 /0xxx	Long Plain	Vs	Pm	Fsw	G	Fw
LOP1 /1cxx	Long Plain	Vs	Fsw	Fsw	G	Fw
LRY	Leary	Vs	Pm	G	G	G
LRY /1cxx	Leary	Vs	Pm	G	G	G
LRY /xd1x	Leary	Vs	Pm	G	G	G

TABLE 14. SUITABILITY RATINGS OF SOILS FOR RECREATIONAL USES

Map Symbol and Phase	Soil Name	Play Ground	Picnic Area	Camp Area	Path And Trails	Permanent Bldgs. Without Basements
LRY /2d2x	Leary	Vs	Pm	Fp	G	Fp
LSL	La Salle	Fs	Fs	Fs	Fs	Pi
LSL /xcxx	La Salle	Fst	Fs	Fs	Fs	Pi
MFI /xx3x	Mansfield	Psq	Fsw	Fsw	Fw	Fw
MHC	Marsh Complex	Vw	Vw	Vw	Vw	Vw
MOW	Mowbray	Fs	Fs	Fs	Fs	Fs
MRH	Marringhurst	Pmq	Pm	G	G	G
MRS	Morris	Ps	Ps	Ps	Ps	Pa
MRS /xxxs	Morris	Ps	Ps	Ps	Ps	Pa
MXS	Manitou	Fs	Fs	Fs	Ps	Pa
MYT	Myrtle	Fs	Fs	Fs	Fs	Pa
MYT /0xxx	Myrtle	Fs	Fs	Fs	Fs	Pa
NBG	Neuenberg	Fw	Fw	Fw	Fw	Faw
NBG /xxxs	Neuenberg	Pn	Fw	Fw	Fw	Faw
NBG /xxxt	Neuenberg	Pnw	Fnw	Fnw	Fnw	Fnw
NKK	Nikkel	Fws	Fws	Fws	Fws	Fwa
NKK /xx1x	Nikkel	Fws	Fsw	Fsw	Fsw	Faw
NKK /xx1s	Nikkel	Fws	Fsw	Fsw	Fsw	Faw
NKK /xxxs	Nikkel	Fws	Fsw	Fsw	Fsw	Faw
NOW	Nowell	Fws	Fsw	Fsw	Fsw	Faw
NTO	Nanton	Fws	Fsw	Fw	Fsw	Fw
NTO /xx1s	Nanton	Fws	Fsw	Fw	Fws	Fw
NUH	Neuhorst	Fsw	Fsw	Fsw	Fws	Faw
NUH /xxxs	Neuhorst	Pnw	Fs	Fs	Fws	Faw
NWN	Newton Siding	Fsw	Fsw	Fsw	Fws	Faw
NWN /xxxs	Newton Siding	Fsw	Fsw	Fsw	Fws	Faw
NWN /xxxt	Newton Siding	Pn	Pn	Fsw	Fws	Faw
OAY	Oakley	Fst	Fs	Fs	Fs	Fa
OAY /xcxx	Oakley	Fst	Fs	Fs	Fs	Fa
OAY /xc1x	Oakley	Fst	Fs	Fs	Fs	Fa
OAY /xc4x	Oakley	Pp	Pp	Pp	Pp	Pp
OAY /1d1x	Oakley	Pt	Fs	Fs	Fs	Fa
OBO	Osborne	Vw	Psw	Psw	Psw	Paw
OBO /xxxs	Osborne	Vw	Pws	Pws	Pws	Paw
OBOd /xxxt	Osborne	Vw	Psw	Psw	Psw	Paw
OBOd	Osborne	Vw	Vs	Vs	Vs	Va
OBOp	Osborne	Vws	Vws	Vws	Vws	Va
OBOdp	Osborne	Vw	Vs	Vs	Vs	Va
OWK	Osterwick	Vw	Vw	Vw	Pw	Pw
OWKd	Osterwick	Vsw	Vs	Vs	Vs	Va

TABLE 14. SUITABILITY RATINGS OF SOILS FOR RECREATIONAL USES

Map Symbol and Phase	Soil Name	Play Ground	Picnic Area	Camp Area	Path And Trails	Permanent Bldgs. Without Basements
OWKdp	Osterwick	Vsw	Vs	Vs	Vs	Va
OWKp	Osterwick	Vsw	Vsw	Vsw	Vsw	Va
PBI	Pembina	Fs	Fs	Fs	Fs	Fa
PBI /xcxx	Pembina	Fst	Fs	Fs	Fs	Fa
PBI /1c1x	Pembina	Fst	Fs	Fs	Fs	Fs
PBI /xdxx	Pembina	Pt	Fs	Fs	Fs	Fa
PBI /1d1x	Pembina	Pt	Fs	Fs	Fs	Fa
PBI /xe1x	Pembina	Vt	Fst	Fst	Fs	Fat
PBI /1e1x	Pembina	Vt	Fst	Fst	Fs	Fat
PER	Perillo	Vsw	Vsw	Vsw	Vsw	Va
PERd	Perillo	Vsw	Vsw	Vsw	Vsw	Va
PER1	Perillo	Vsw	Vsw	Vsw	Vsw	Va
PGK	Pigeon Lake	Fsw	Fsw	Fsw	Fsw	Pi
PME	Plum Coulee	Ps	Ps	Ps	Ps	Pa
PME1	Plum Coulee	Fs	Fs	Fs	Fs	Paf
PME /xxxs	Plum Coulee	Ps	Ps	Ps	Ps	Pa
POU	Pouchal	Vw	Vw	Vw	Pw	Vh
POU /xcxx	Pouchal	Vw	Vw	Vw	Pw	Vh
PYR	Poyser	Fs	Fs		Fs	Fa
PYR /xd1x	Poyser	Pt	Fs	Fs	Fs	Fa
RBK	Rosebank	Fw	Fw	Fw	Fw	Fw
RBK1	Rosebank	Fw	Fw	Fw	Fw	Fw
RFD	Reinfeld	G	G	G	G	Fa
RFD /1xxx	Reinfeld	G	G	G	G	Fa
RGD	Rignold	Fw	Fw	Fw	Fw	Fa
RIV	Red River	Ps	Ps	Ps	Ps	Pa
RIV /xxxs	Red River	Ps	Ps	Ps	Ps	Pa
RLD	Reinland	Fw	Fw	Fw	Fw	Fw
RLD /xcxx	Reinland	Fwt	Fw	Fw	Fw	Fw
RLD /xxxs	Reinland	Fw	Fw	Fw	Fw	Fw
RLD /1xxx	Reinland	Fw	Fw	Fw	Fw	Fw
RSG	Rosengart	G	G	G	G	G
RSI	Roseisle	Fks	Fs	Fks	Fs	Fa
RSI /xcxx	Roseisle	Ft	Fs	Fks	Fs	Fa
RSI /xx1x	Roseisle	Fs	Fs	Fks	Fs	Fa
RSI /xc1x	Roseisle	Ft	Fs	Fks	Fs	Fa
RSI /xc2x	Roseisle	Fpt	Fp	Fps	Fs	Fp
RSI /xd1x	Roseisle	Pt	Fs	Fks	Fs	Fa
RSI /xx3x	Roseisle	Pp	Fsp	Pp	Fsp	Pp
RSI /xx5x	Roseisle	Vp	Vp	Vp	Vp	Vp

TABLE 14. SUITABILITY RATINGS OF SOILS FOR RECREATIONAL USES

Map Symbol and Phase	Soil Name	Play Ground	Picnic Area	Camp Area	Path And Trails	Permanent Bldgs. Without Basements
RSI /1e5x	Roseisle	Vpt	Vp	Vp	Vp	Vp
RWL	Rathwell	Fsw	Fsw	Fsw	Fsw	Faw
SCK	Stockton	Fs	Fs	Fs	G	G
SCK /xcxx	Stockton	Fst	Fs	Fs	G	G
SCY	Scanterbury	Ps	Ps	Ps	Ps	Pa
SKL	Skelding	Vs	Pm	Fs	Ps	G
SKL /xcxx	Skelding	Ps	Fs	Fs	Ps	G
SKL /xdxx	Skelding	Vst	Pm	Fst	Ps	Ft
SKL /xexx	Skelding	Vt	Fst	Fst	Ps	Ft
SKL /xfxx	Skelding	Vst	Pmt	Pt	Ps	Pt
SKL /xgxx	Skelding	Vst	Vt	Vt	Ps	Vt
SKL /xhxx	Skelding	Vst	Vt	Vt	Vt	Vt
SKLa /xexx	Skelding	Vst	Vs	Vs	Ps	Ft
SKLa /xfxx	Skelding	Vst	Vs	Vs	Vs	Pt
SKLa /xhxx	Skelding	Vst	Vst	Vst	Vst	Vt
SKL1 /xcxx	Skelding	Vst	Pm	Fs	Ps	G
SKL1 /xdxx	Skelding	Vst	Pm	Fs	Ps	G
SKL1 /xexx	Skelding	Vst	Pm	Fst	Ps	Pt
SKL1a/xexx	Skelding	Vst	Pm	Fst	Ps	Pt
SKL1 /xgxx	Skelding	Vst	Vt	Vt	Pst	Vt
SKL1a/xgxx	Skelding	Vst	Vt	Vt	Pst	Vt
SKL1 /xfxx	Skelding	Vst	Pmt	Pt	Ps	Pt
SQR	Squirrel Creek	Pw	Pw	Pw	Fsw	Pf
SQR /xxxs	Squirrel Creek	Pnw	Pw	Pw	Fsw	Pf
SQR /xxxt	Squirrel Creek	Pnw	Pnw	Pwn	Fsw	Pf
SUE	St.Claude	Pw	Pw	Pw	Fsw	Pf
SUE /xxxs	St.Claude	Pwn	Pw	Pw	Fsw	Pf
SUE /xxxu	St.Claude	Vn	Vn	Vn	Fsw	Pf
SUE /0xxx	St.Claude	Pw	Pw	Pw	Fsw	Pf
SUE1	St.Claude	Pw	Pw	Pw	Fsw	Pf
SXG	Stallar	Pd	Pm	Fs	Fs	Pd
SXG /xc4x	Stallar	Pdp	Pp	Pp	Pp	Pdp
SXG /xdxx	Stallar	Pdt	Pm	Fs	Fs	Pd
SXG /xd1x	Stallar	Pdt	Pm	Fs	Fs	Pd
SXG /xe4x	Stallar	Vt	Pp	Pp	Pp	Pdp
SXG /1fxx	Stallar	Vt	Pt	Pt	Fst	Pd
TDW	Tredwell	Vw	Vw	Vw	Pw	Pw
TLI	Tellier	Fsw	Fsw	Fsw	Fsw	Faw
TNT /1d1x	Trinton	Pq	G	G	G	G
ULH	Ullrich	Fsw	Fsw	Fsw	Fsw	Faw

TABLE 14. SUITABILITY RATINGS OF SOILS FOR RECREATIONAL USES

Map Symbol and Phase	Soil Name	Play Ground	Picnic Area	Camp Area	Path And Trails	Permanent Bldgs. Without Basements
ULH /xx1x	Ullrich	Fsw	Fsw	Fsw	Fsw	Faw
ULH /xc2x	Ullrich	Fsw	Fsw	Fsw	Fsw	Fap
VDL	Vandal	Pq	Pm	G	G	G
VDL /xc1x	Vandal	Pq	Pm	G	G	G
VDL /1c1x	Vandal	Pq	Pm	G	G	G
VTL	Vartel	Fsw	Fws	Fws	Fsw	Fw
WIK	Winkler	Ps	Fs	Fs	Fs	Pa
WIK /xcxx	Winkler	Ps	Fs	Fs	Fs	Pa
WIK /xdxx	Winkler	Pst	Fs	Fs	Fs	Pa
WIK2	Winkler	Ps	Fs	Fs	Fs	Pa
WIK2 /xexx	Winkler	Vt	Fs	Fs	Fs	Pa
WIK2 /xfxx	Winkler	Vt	Ft	Pt	Fst	Pat
WOR /1c1x	Worden	Fs	Fs	Fs	Fs	Fa
WWB	Willowbend	Viw	Viw	Viw	Viw	Viw
WWC	Willowcrest	Fsw	Fsw	Fsw	G	Fw
WWC /xcxx	Willowcrest	Fwt	Fsw	Fsw	G	Fw
WWC /1xxx	Willowcrest	Fsw	Fsw	Fsw	G	Fw
WWC /2xxx	Willowcrest	Fsw	Fsw	Fsw	G	Fw
WWC /0xxx	Willowcrest	Pm	Pm	Fsw	G	Fw
WWC /1cxx	Willowcrest	Fst	Fsw	Fsw	G	Fw
WWC /2cxx	Willowcrest	Ps	Ps	Fs	G	Fw
WWC1	Willowcrest	Fsw	Fs	Fs	G	Fw
XVI	Xavier	Vsw	Vsw	Vsw	Vsw	Vaw
YTK /xx2t	Yustak	Vwq	Pwn	Pwn	Pw	Pw
ZIM	Zinman	Pws	Pws	Pws	Ps	Ps
ZIM /xxxs	Zinman	Pws	Pws	Pws	Ps	Ps
ZPI	Zaplin	Fsw	Fws	Fsw	Fsw	Faw
ZPI /xcxx	Zaplin	Fsw	Fws	Fsw	Fsw	Faw
ZPI /xexx	Zaplin	Vt	Fws	Fst	Fsw	Faw

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Appendix A

GLOSSARY

AASHO classification (soil engineering) - The official classification of soil materials and soil aggregate mixtures for highway construction used by the American Association of State Highway Officials.

Acid soil - A soil having a pH less than 7. See pH and Reaction, soil.

Alkaline soil - A soil having a pH greater than 7. See Reaction, soil.

Alluvium - A general term for all deposits of rivers and streams.

Arable soil - Soil suitable for plowing and cultivation.

Association - A sequence of soils of about the same age, derived from similar parent material, and occuring under similar climatic conditions but showing different characteristics due to variations in relief and in drainage.

1/3 Atmosphere Moisture - The moisture percentage on dry weight basis of a soil sample that has been air dried, screened, saturated and subjected to a soil moisture tension of 345 cm of water through a permeable membrane for a period of 48 hours. It approximates the soil moisture retention capacity.

Available nutrient - That portion of any element or compound in the soil that can be readily absorbed and assimilated by growing plants.

Available soil moisture - The portion of water in a soil that can be readily absorbed by plant roots: generally considered to be that water held in the soil up to approximately 15 atmospheres pressure.

Bearing capacity - Capacity of soil (in moist to wet conditions) to support loads such as buildings, people, vehicles, and animals.

Bedrock - The solid rock that underlies soil and regolith or that is exposed at the surface.

Boulders - Stones which are larger than 60 cm in diameter.

Bulk density - The weight of oven dry soil (105 degrees C) divided by its volume at field moisture conditions, expressed in grams per cubic centimeter.

Buried soil - Soil covered by an alluvial, loessial, or other deposit, usually to a depth greater than the thickness of the solum.

Calcareous soil - Soil containing sufficient calcium carbonate (often with magnesium carbonate) to effervesce visibly when treated with hydrochloric acid.

Calcium Carbonate Equivalent - Refers to the percent of carbonates in

the soil expressed on the basis of calcium carbonate. Terms used to express the carbonate contents of soils are:

noncalcareous	<1%
weakly calcareous	1-5%
moderately calcareous	.6-15%
strongly calcareous	16-25%
v. strongly calcareous	26-40%
extremely calcareous	>40%

Capillary fringe - A zone of essentially saturated soil just above the water table. The size distribution of the pores determines the extent and degree of the capillary fringe.

Carbon-nitrogen ratio (C/N ratio) - The ratio of the weight of organic carbon to the weight of total nitrogen in a soil or in an organic material.

Cation Exchange Capacity (CEC) - A measure of the total amount of exchangeable cations that can be held by a soil. Expressed in milliequivalents per 100g of soil.

Clay - As a soil separate, the mineral soil particles less than 0.002 mm in diameter: usually consisting largely of clay minerals. As a soil textural class, soil materials that contain 40 or more percent clay, less than 45 percent sand and less than 40 percent silt.

Cobbles - Rock fragments 8 to 25 cm in diameter.

Color - Soil colors are compared with a Munsell color chart. The Munsell system specifies the relative degrees of the three simple variables of color: hue, value and chroma. For example: 10YR 6/4 means a hue of 10YR, a value of 6, and a chroma of 4.

Complex (soil) - A mapping unit used in detailed and reconnaissance soil surveys where two or more soil series that are so intimately intermixed in an area that it is impractical to separate them at the scale of mapping used.

Concretions - Hard grains, pellets or nodules from concentration of compounds in the soil that cement soil grains together.

Conductivity, electrical - A physical quantity that measures the readiness with which a medium (irrigation water and soil extracts) transmits electricity. It expresses the concentration of salt in terms of the conductance (reciprocal of the electric resistance in ohms) in milliSiemens per cm (or expressed as deciSiemens per meter - dS/m).

Consistence (soil) - The mutual attraction of the particles in a soil mass, or their resistence to separation or deformation. It is described in terms such as loose, soft, friable, firm, hard, sticky, plastic or cemented.

Consumptive use factor (CU) - The ratio of consumptive use of water by a crop to potential evapotranspiration. and transpiration. An actively growing crop that completely covers the soil over a large area and that has an ample supply of readily available soil water has a consumptive use factor of 1.0.

Consumptive use of water - The sum of the depths of water transpired by the plants and evaporated from the soil surface and from intercepted precipitation. It may be less or greater than potential evapotranspiration.

Contour - An imaginary line connecting points of equal elevation on the surface of the soil.

Cover - This term generally has one of the following meanings:

1. Vegetation or other material providing protection

2. In forestry, low growing shrubs and herbaceous plants under trees (i.e., ground cover vs. tree cover)

3. Any vegetation producing a protective mat on or just above the soil surface.

Creep (soil) - Slow mass movement of soil and soil material down rather steep slopes primarily under the influence of gravity, but aided by saturation with water and by alternate freezing and thawing.

Decile portion - A one-tenth portion. As used in the soil map symbol A7-B3 means that the A soils cover seven tenths and the B soils cover three tenths of the map unit.

Delta - A fluvial or glaciofluvial fan shaped deposit at the mouth of a river that empties into a lake or sea.

Deflocculate - To separate or to break up soil aggregates into individual particles by chemical or physical means or both.

Degradation (of soils) - The changing of a soil to a more highly leached and more highly weathered condition, usually accompanied by morphological changes such as the development of an eluviated light colored (Ae) horizon.

Dispersion - Is rated high, moderate or low depending on how readily the soil structure breaks down or slakes because of excess moisture. A rating of high indicates that soil aggregates slake readily; a rating of low indicates that aggregates are resistant to dispersion and remain clumped together.

Drainage (soil) - (1) The rapidity and extent of the removal of water from the soil by runoff and flow through the soil to underground spaces. (2) As a condition of the soil, it refers to the frequency and duration of periods when the soil is free of saturation.

Drainage in soil reports is described on the basis of actual moisture content in excess of field capacity and length of the saturation period within the plant root zone. The terms are as follows:

Very rapidly drained - Water is removed from the soil very rapidly in relation to supply. Excess water flows downward very rapidly if underlying material is pervious. There may be very rapid subsurface flow during heavy rainfall provided there is a steep gradient. Soils have very low available water storage capacity (usually less than 2.5 cm) within the control section and are usually coarse in texture, or shallow, or both. Water source is precipitation.

Rapidly drained - Water is removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow may occur on steep gradients during heavy rainfall. Soils have low available water storage capacity (2.5-4 cm) within the

control section, and are usually coarse in texture, or shallow, or both. Water source is precipitation.

Well drained - Water is removed from the soil readily but not rapidly. Excess water flows downward readily into underlying pervious material or laterally as subsurface flow. Soils have intermediate available water storage capacity (4-5 cm) within the control section, and are generally intermediate in texture and depth. Water source is precipitation. On slopes subsurface flow may occur for short durations but additions are equaled by losses. These soils are usually free of mottles within 100 cm of the surface but may be mottled below this depth. Soil horizons are usually bright colored.

Moderately well drained - Water is removed from the soil somewhat slowly in relation to supply. Excess water is removed somewhat slowly due to low perviousness, shallow water table, lack of gradient, or some combination of these. Soils have intermediate to high water storage capacity (5-6cm) within the control section and are usually medium to fine in texture. Soils are commonly mottled in the 50 to 100 cm depth. Colors are dull brown in the subsoil with stains and mottles.

Imperfectly drained - Water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season. Excess water moves slowly downward if precipitation is major supply. If subsurface water or groundwater, or both, is the main source, flow rate may vary but the soil remains wet for a significant part of the growing season. Precipitation is the main source if available water storage capacity is high; contribution by subsurface flow or groundwater flow, or both, increases as available water storage capacity decreases. Soils have a wide range in available water supply, texture, and depth, and are gleyed phases of well drained subgroups. These soils generally have mottling below the surface layers and generally have duller colors with depth, generally brownish gray with mottles of yellow and gray.

Poorly drained - Water is removed so slowly in relation to supply that the soil remains wet for a comparatively large part of the time the soil is not frozen. Excess water is evident in the soil for a large part of the time. Subsurface flow or groundwater flow, or both, in addition to precipitation are main water sources; there may also be a perched water table, with precipitation exceeding evapotranspiration. Poorly drained soils have a wide range in available water storage capacity, texture, and depth, and are gleyed subgroups, Gleysols, and Organic soils.

Very poorly drained - Water is removed from the soil so slowly that the water table remains at or on the surface for the greater part of the time the soil is not frozen. Excess water is present in the soil for the greater part of the time. Groundwater flow and subsurface flow are major water sources. Precipitation is less important except where there is a perched water table with precipitation exceeding evapotranspiration. These soils have a wide range in available water

storage capacity, texture, and depth, and are either Gleysolic or Organic.

Dryland farming - The practice of crop production in low rainfall areas without irrigation.

Eluvial horizon - A horizon from which material has been removed in solution or in water suspension.

Eolian - Soil material accumulated through wind action.

Erosion - The wearing away of the land surface by detachment and transport of soil and rock material through the action of moving water, wind or other geological processes. The ratings of erosion are:

Erosion 1 slightly eroded - soil with a sufficient amount of the A horizon removed that ordinary tillage will bring up and mix the B horizon or other lower lying horizons with surface soil in the plow layer.

Erosion 2 moderately eroded - soil with all of the A horizon and a part of the B or other lower lying horizons removed. The plow layer consists mainly of the original horizons below the A or below the original plow layer.

Erosion 3 severely eroded - soils have practically all of the original surface soil removed. The plow layer consists mainly of C horizon material, especially on knolls and steep upper slope positions.

Evapotranspiration - The combined loss of water from a given area, and during a specific period of time, by evaporation from the soil surface and transpiration from plants.

Field Moisture Equivalent - The minimum moisture content at which a drop of water placed on a smoothed surface of the soil will not be absorbed immediately by the soil, but will spread out over the surface and give it a shiny appearance.

Flood plain - The land bordering a stream, built up of sediments from overflow of the stream and subject to inundation when the stream is at flood stage.

Fluvial deposits - All sediments past and present, deposited by flowing water, including glaciofluvial deposits.

Frost heave - The raising of the surface caused by ice in the subsoil.

Friable - Soil aggregates that are soft and easily crushed between thumb and forefinger.

Glaciofluvial deposits - Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. These deposits are stratified and may occur in the form of outwash plains, deltas, kames, eskers and kame terraces.

Gleyed soil - An imperfectly or poorly drained soil in which the material has been modified by reduction or alternating reduction and oxidation. These soils have

lower chromas or more prominent mottling or both in some horizons than the associated well-drained soil.

Gleysolic - An order of soils developed under wet conditions and permanent or periodic reduction. These soils have low chromas or prominent mottling or both, in some horizons.

Gravel - Rock fragments 2 mm to 7.5 cm in diameter.

Ground Moraine - An unsorted mixture of rocks, boulders, sand, silt and clay deposited by glacial ice. The predominant material is till; most till is thought to have accumulated under the ice by lodgment, but some till has been let down from the upper surface of the ice by ablation. Resorting and modification may have taken place to some extent by wave-action of glacial melt waters. The topography is most commonly in the form of undulating plains with gently sloping hills and enclosed depressions.

Groundwater - Water beneath the soil surface, usually under conditions where the voids are completely filled with water (saturation).

Halophytic vegetation - vegetation that grows naturally in soils having a high content of various salts. It usually has fleshy leaves or thorns and resembles desert vegetation.

Horizon (soil) - A layer in the soil profile approximately parallel to the land surface with more or less well-defined characteristics that have been produced through the operation of soil forming processes.

Horizon boundary - The lower boundary of each horizon is described by indicating its distinctness and form. The distinctness depends on the abruptness of vertical change (thickness). The form refers to the variation of the boundary plane.

Distinctness -
abrupt - less than 2 cm
clear - 2 to 5 cm
gradual - 5 to 15 cm
diffuse - more than 15 cm

Form -
smooth - nearly plain
wavy - pockets are wider than deep
irregular - pockets are deeper than wide
broken - parts of the horizon are unconnected with other parts

Humic layer - A layer of highly decomposed organic soil material containing little fibre.

Hydraulic Conductivity - Refers to the effective flow velocity or discharge velocity in soil at unit hydraulic gradient. It is an approximation of the permeability of the soil and is expressed in cm per hour. The classes are described in general or specific terms as:

High	>15	Very rapid	>50
		Rapid	15-50
Medium	0.5-15	Mod. rapid	5.0-15
		Moderate	1.5-5.0
		Mod. slow	0.5-1.5
Low	<0.5	Slow	0.15-0.5
		Very slow	0.015-0.15
		Extremely slow	<.015

Hydrologic cycle - The conditions through which water naturally passes from the time of precipitation until it is returned to

the atmosphere by evaporation and is again ready to be precipitated.

Hydrophyte - Plants growing in water or dependent upon wet or saturated soil conditions for growth.

Illuvial horizon - A soil horizon in which material carried from an overlying layer has been precipitated from solution or deposited from suspension. The layer of accumulation.

Impeded drainage - A condition that hinders the movement of water by gravity through the soils.

Inclusion - Soil type found within a mapping unit that is not extensive enough to be mapped separately or as part of a complex.

Infiltration - The downward entry of water into the soil

Irrigation - The artificial application of water to the soil for the benefit of growing crops.

Irrigation requirement (IR) - Refers to the amount of water exclusive of effective precipitation that is required for crop production.

Lacustrine deposits - Material deposited by or settled out of lake waters and exposed by lowering of the water levels or elevation of the land. These sediments range in texture from sand to clay and are usually varved (layered annual deposits).

Landforms - See Description of Landforms

Landscape - All the natural features such as fields, hills, forest, water, etc., which distinguish one part of the earth's surface from another part.

Leaching - The removal from the soil of materials in solution.

Liquid limit (upper plastic limit) - The water content corresponding to an arbitrary limit between the liquid and plastic states of consistency of a soil. The water content at this boundary is defined as that at which a pat of soil cut by a groove of standard dimensions will flow together for a distance of 1.25 cm under the impact of 25 blows in a standard liquid limit apparatus.

Lineal shrinkage - This is the decrease in one dimension expressed as a percentage of the original dimension of the soil mass when the moisture content is reduced from a stipulated percentage (usually field moisture equivalent) to the shrinkage limit.

Mapping Unit - Any delineated area shown on a soil map that is identified by a symbol. A mapping unit may be a soil unit, a miscellaneous land type, or a soil complex.

Marsh - Periodically flooded or continually wet areas having the surface not deeply submerged. It is covered dominantly with sedges, cattails, rushes or other hydrophytic plants.

Mature soil - A soil having well-developed soil horizons produced by the natural processes of soil formation.

Mesophyte - Plants requiring intermediate moisture conditions and are not very resistant to drought.

Microrelief - Small-scale, local differences in relief including mounds, swales or hollows.

Milliequivalent (me) - One-thousandth of an equivalent. An equivalent is the weight in grams of an ion or compound that combines with or replaces one gram of hydrogen. The atomic or formula weight divided by valence.

Mottles - Irregularly marked spots or streaks, usually yellow or orange but sometimes blue. They are described in order of abundance (few, common, many), size (fine, medium, coarse) and contrast (faint, distinct, prominent). Mottles in soils indicate poor aeration and lack of good drainage.

Organic carbon - Carbon derived from plant and animal residues.

Organic matter - The fraction of the soil which consists of plant and animal residues at various stages of decomposition, cells and tissues of soil organisms and substances synthesized by the soil population. It is determined on soils that have been sieved through a 2.0 mm sieve. It is estimated by multiplying the organic carbon by a factor of 1.72.

Outwash - Sediments "washed out" beyond the glacier by flowing water and laid down in thin beds or strata. Particle size may range from boulders to silt.

Ovendry soil - Soil that has been dried at 105 degrees C until it has reached constant weight.

Parent material - The unaltered or essentially unaltered mineral or organic material from which the soil profile develops by pedogenic processes.

Particle size, soil - The grain size distribution of the whole soil including the coarse fraction. It differs from texture, which refers to the fine earth (less than 2mm) fraction only. In addition, textural classes are usually assigned to specific horizons whereas soil family particle-size classes indicate a composite particle size of a part of the control section that may include several horizons. See Textural Triangle at end of Glossary.

The particle-size classes for family groupings are as follows:

Fragmental Stones, cobbles and gravel, with too little fine earth to fill interstices larger than 1 mm.

Sandy-skeletal Particles coarser than 2 mm occupy 35% or more by volume with enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is that defined for the sandy particle-size class.

Loamy-skeletal Particles 2 mm-25 cm occupy 35% or more by volume with enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is that defined for the loamy particle-size class.

Clayey-skeletal Particles 2 mm-25 cm occupy 35% or more by volume with enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is that defined for the clayey particle-size class.

Sandy The texture of the fine earth includes sands and loamy sands, exclusive of loamy very fine sand and very fine sand textures; particles 2 mm- 25 cm occupy less than 35% by volume.

Loamy The texture of the fine earth includes loamy very fine sand, very fine sand, and finer textures with less than 35% clay; particles 2 mm-25 cm occupy less than 35% by volume.

Coarse-loamy. A loamy particle size that has 15% or more by weight of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has less than 18% clay in the fine earth fraction.

Fine-loamy. A loamy particle size that has 15% or more by weight of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has 18-35% clay in the fine earth fraction.

Coarse-silty. A loamy particle size that has less than 15% of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has less than 18% clay in the fine earth fraction.

Fine-silty. A loamy particle size that has less than 15% of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has 18-35% clay in the fine earth fraction.

Clayey. The fine earth contains 35% or more clay by weight and particles 2mm-25 cm occupy less than 35% by volume.

Fine-clayey. A clayey particle size that has 35-60% clay in the fine earth fraction.

Very-fine-clayey. A clayey particle size that has 60% or more clay in the fine earth fraction.

Ped - An individual soil aggregate such as granule, prism or block formed by natural processes (in contrast with a clod which is formed artificially).

Pedology - Those aspects of soil science involving constitution, distribution, genesis and classification of soils.

Percolation - The downward movement of water through soil; specifically, the downward flow of water in saturated or nearly saturated soil at hydraulic gradients of 1.0 or less.

Permafrost -

1. Perennially frozen material underlying the solum.

2. A perennially frozen soil horizon.

Permafrost table - The upper boundary of permafrost, usually coincident with the lower limit of seasonal thaw (active layer).

Permeability - The ease with which water and air pass through the soil to all parts of the profile. See hydraulic conductivity.

pH - The intensity of acidity and alkalinity, expressed as the negative logarithm of the hydrogen ion concentration. A pH of 7 is neutral, lower values indicate acidity and higher values alkalinity (see Reaction, soil).

Phase, soil - A soil phase is used to characterize soil and landscape properties that are not used as criteria in soil taxonomy. The major phase differentiae are: slope, erosion, deposition, stoniness, texture, salinity, and calcareousness.

Plastic Limit - The water content corresponding to an arbitrary limit between the plastic and the semisolid states of consistency of a soil.

Plasticity Index - The numerical difference between the liquid and the plastic limit. The plasticity index gives the range of moisture contents within which a soil exhibits plastic properties.

Potential evapotranspiration (PE) - The maximum quantity of water capable of being lost as water vapor, in a given climate, by a continuous stretch of vegetation covering the whole ground and well supplied with water.

Profile, soil - A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil - The acidity or alkalinity of a soil. Soil reaction classes are characterized as follows:

extremely acid	pH <4.5
very strongly acid	4.5 to 5.0
strongly acid	5.1 to 5.5
medium acid	5.6 to 6.0
slightly acid	6.1 to 6.5
neutral	6.6 to 7.3
mildly alkaline	7.4 to 7.8
mod. alkaline	7.9 to 8.4
strongly alkaline	8.5 to 9.0
very strongly alkaline	>9.0

Regolith - The unconsolidated mantle of weathered rock and soil material on the earth's surface.

Relief - The elevation of inequalities of the land surface when considered collectively.

Runoff - The portion of the total precipitation on an area that flows away through stream channels. Surface runoff does not enter the soil. Groundwater runoff or seepage flow from groundwater enters the soil before reaching the stream.

Saline Soil - A nonalkali soil containing soluble salts in such quantities that they interfere with the growth of most crop plants. The conductivity of the saturation extract is greater than 4 millisiemens/cm (ms/cm), the exchangeable-sodium percentage is less than 15, and the pH is usually less than 8.5. Approximate limits of salinity classes are:

non-saline	0 to 4 ms/cm
weakly saline	4 to 8 mS/cm
mod. saline	8 to 15 ms/cm
strongly saline	>15 ms/cm

Salinization - The process of accumulation of salts in the soil.

Salt-Affected Soil - Soil that has been adversely modified for the growth of most crop plants by the presence of certain types of exchangeable ions or of soluble salts. It includes soils having an excess of salts, or an excess of exchangeable sodium or both.

Sand - A soil particle between 0.05 and 2.0 mm in diameter. The textural class name for any soil containing 85 percent or more of sand and not more than 10 percent of clay.

Saturation Percentage - The moisture percentage of a saturated soil paste, expressed on an oven dry weight basis.

Seepage -

1. The escape of water downward through the soil.

2. The emergence of water from the soil along an extensive line of surface in contrast to a spring where water emerges from a local spot.

Series, soil - A category in the Canadian System of Soil Classification. It consists of soils that have soil horizons similar in their differentiating characteristics and arrangement in the profile, except for surface texture and are formed from a particular type of parent material.

Shrinkage limit - This is the moisture content at which an equilibrium condition of volume change is reached and further reduction in moisture content will not cause a decrease in the volume of the soil mass.

Shrinkage ratio - This is the ratio between the volume change and a corresponding change in moisture content. It equals the apparent specific gravity of the dried soil.

Silt - (a) Individual mineral particles of soil that range in diameter between 0.05 to .002 mm. (b) Soil of the textural class silt contains greater than 80 percent silt and less than 12 percent clay.

Slickenside - Smoothed surfaces along planes of weakness resulting from the movement of one mass of soil against another in soils dominated by swelling clays.

Sodium-Adsorption Ratio (S.A.R.) - A ratio for soil extracts and irrigation waters used to express the relative activity of sodium ions in exchange reactions with other cations in the soil SAR = $Na/((Ca+Mg)/2)^{1/2}$ where the cation concentrations are expressed as milliequivalents per litre.

Soil - The unconsolidated mineral material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. Soil has been subjected to and influenced by genetic and environmental factors of: parent material, climate (including moisture and temperature effects), macro- and micro-organisms, and topography, all acting over a period of time.

Solum - The upper horizons of a soil above the parent material and in which the processes of soil formation are active. It usually comprises the A and B horizons.

Stones - Rock fragments greater than 25 cm in diameter.

Stoniness - The percentage of land surface occupied by stones. The classes of stoniness are defined as follows:

Stones 0. Nonstony -- Land having less than 0.01% of surface occupied by stones.

Stones 1. Slightly stony -- Land having 0.01-0.1% of surface occupied by stones. Stones 15-30 cm in diameter, 10-30 m apart. The stones offer only slight to no hindrance to cultivation.

Stones 2. Moderately stony -- Land having 0.1-3% of surface occupied by stones. Stones 15-30 cm in diameter, 2-10 m apart. Stones cause some interference with cultivation.

Stones 3. Very stony -- Land having 3-15% of surface occupied by stones. Stones 15-30 cm in diameter, 1-2 m apart. There are sufficient stones to constitute a serious handicap to cultivation.

Stones 4. Exceedingly stony -- Land having 15-50% of surface occupied by stones. Stones 15-30 cm in diameter, 0.7-1.5 m apart. There are sufficient stones to prevent cultivation until considerable clearing has been done.

Stones 5. Excessively stony -- Land having more than 50% of surface occupied by stones. Stones 15-30 cm in diameter, less than 0.7 m apart. The land is too stony to permit cultivation.

Storage Capacity - Refers to the maximum amount of readily available water that can be stored within the rooting zone of a crop in a given soil. For practical irrigation purposes, 50 percent of the total soil water between field capacity and wilting point may be considered as readily available.

Stratified materials - Unconsolidated sand, silt and clay arranged in strata or layers. In stratified materials, a bed is a unit layer distinctly separable from other layers and is one or more cm thick but a lamina is a similar layer less than 1 cm thick.

Structure - The combination or arrangement of primary soil particles into aggregates of secondary soil particles, units or peds, which are separated from each other by surfaces of weakness. Structure is expressed in terms of grade, size class and shape type. Grade refers to the distinctness of aggregate development, and is described as structureless, weak, moderate or strong. Structureless refers to the absence of observable aggregation of definite orderly arrangement; the term amorphous is used if soil is massive or coherent, single-grained if noncoherent. The weak to strong aggregates vary in size and are described by class as fine, medium, coarse, and very coarse depending on the shape types. The shape types refers to the dominant configuration of the aggregates and the way they are accommodated. The general shape types are plate-like, block-like and prism-like. The terms are:

Platy - Having thin, plate-like aggregates with faces mostly horizontal

Prismatic - Having prism-like aggregates with tops and edges, appear plane, level and somewhat angular.

Columnar - Having prism-like aggregates with vertical edges near the top of columns, not sharp.

Granular - Having block-like aggregates that appear as spheroids or polyhedrons having plane or curved surfaces which have slight or no accommodation to the faces of the surrounding peds.

Blocky - Having block-like aggregates with sharp, angular corners

Subangular blocky - Having block-like aggregates with rounded and flattened faces and rounded corners.

By convention an aggregate is described in the order of grade, class and type, e.g. strong, medium, blocky. In the parent material of soils the material with structural shapes may be designated as pseudo-blocky, pseudo-platy, etc.

Soil Survey - The systematic examination, description, classification, and mapping of soil in an area.

Sulfate Hazard - Refers to the relative degree of attack on concrete by soil and water containing various amounts of sulfate ions. It is estimated from electrolyte measurements and salt analysis on selected profiles and soil samples, and by visual examination of free gypsum within the profile during the course of soil investigation.

Swamp - See Description of Landforms

Texture, soil - The relative proportions of the fine earth (less than 2 mm.) fraction of a soil. Textural classes are usually assigned to specific horizons whereas family particle size classes indicate a composite particle size of a portion of the control section that may include several horizons. See Texture Triangle at end of Glossary.

The size range of the constituent primary particles are as follows:

	Diameter (mm)
Very coarse sand. . . .	2.0-1.0
Coarse sand	1.0-0.5
Medium sand	0.5-0.25
Fine sand	0.25-0.10
Very fine sand. . . .	0.10-0.05
Silt.	0.05-0.002
Clay.	< 0.002
Fine clay	< 0.0002

Till, glacial - Unstratified glacial deposits consisting of clay, sand, gravel, and boulders intermingled in any proportion.

Tilth - The physical condition of soil as related to its ease of tillage, fitness as a seedbed, and its impedance to seedling emergency and root penetration.

Topography - Refers to the percent slope and the pattern or frequency of slopes in different directions. A set of 10 slope classes are used to denote the dominant but not necessarily most abundant slopes within a mapping unit.

Slope Class	Slope Name	Percent slope	Approx. degrees
1	level	0-0.5	0
2	nearly level	.5-2.5	.3-1.5
3	very gentle	2-5	1-3
4	gentle	6-9	3.5-5
5	moderate	10-15	6-8.5
6	strong	16-30	9-17
7	very strong	31-45	17-24
8	extreme	46-70	25-35
9	steep	71-100	35-45
10	very steep	>100	>45

Underground runoff - (or seepage)-Water flowing towards stream channels after infiltration into the ground.

Unified Soil Classification System (engineering) - A classification system based on the identification of soils according to their particle size, gradation, plasticity index and liquid limit.

Urban Land - Areas so altered or obstructed by urban works or structures that identification of soils is not feasible.

Variant, soil - A soil whose properties are believed to be sufficiently different from other known soils to justify a new series name, but comprising such a limited geographic area that creation of a new series is not justified.

Varve - A distinct band representing the annual deposit in sedimentary materials regardless of origin and usually consisting of two layers, one thick light colored layer of silt and fine sand laid

down in the spring and summer, and the other a thin, dark colored layer of clay laid down in the fall and winter.

Water balance, soil - Is the daily amount of readily available water retained by the soil. The daily soil-water balance is decreased by the amount that the daily consumptive use exceeds the daily rainfall. When daily rainfall exceeds the consumptive use, the daily balance increases by the amount of the difference unless the soil-water balance is at storage capacity, in which case the excess is assumed to be lost by runoff or deep percolation.

Water table - (groundwater surface; free water surface; groundwater elevation) Elevation at which the pressure in the water is zero with respect to the atmospheric pressure.

Water-holding capacity - The ability of a soil to hold water against the force of gravity in a freely drained soil.

Weathering - The physical and chemical disintegration, alteration and decomposition of rocks and minerals at or near the earth's surface by atmospheric agents.

Xerophyte - Plants capable of surviving extended periods of soil drought.

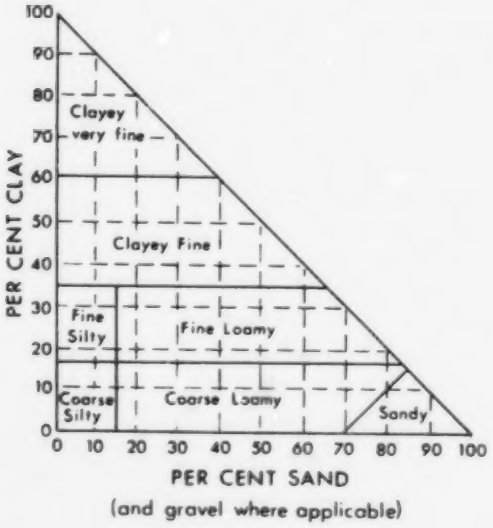
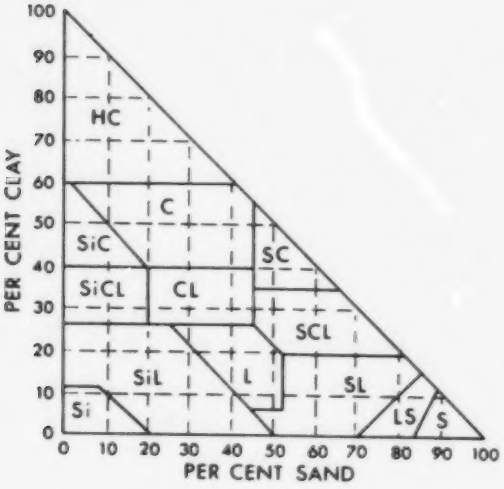


Figure 7: Family particle-size classes.



Texture Group	Class Symbol	Class Name
Coarse	S	sand
	LS	loamy sand
Moderately coarse	SL	sandy loam
	LVFS	loamy very fine sand
Medium	Si	silt
	SiL	silt loam
	L	loam
	VFSL	very fine sandy loam
Moderately fine	SCL	sandy clay loam
	CL	clay loam
	SiCL	silty clay loam
Fine	SC	sandy clay
	C	clay
	SiC	silty clay
Very fine	HC	heavy clay

Figure 8: Soil Textural Classes.

Appendix B

SOIL HORIZON DESIGNATIONS

ORGANIC HORIZONS

Organic horizons are found in Organic soils, and commonly at the surface of mineral soils. They may occur at any depth beneath the surface in buried soils, or overlying geologic deposits. They contain more than 17% organic carbon (approximately 30% organic matter) by weight. Two groups of these horizons are recognized, O horizons and the L, F, and H horizons.

O This is an organic horizon developed mainly from mosses, rushes, and woody materials.

Of The fibric horizon is the least decomposed of all the organic soil materials. It has large amounts of well-preserved fiber that are readily identifiable as to botanical origin. A fibric horizon has 40% or more of rubbed fiber by volume and a pyrophosphate index of 5 or more. If the rubbed fiber volume is 75% or more, the pyrophosphate criterion does not apply.

Om The mesic horizon is the intermediate stage of decompostion with intermediate amounts of fiber, bulk density and water-holding capacity. The material is partly altered both physically and biochemically. A mesic horizon is one that fails to meet the requirements of fibric or humic.

Oh The humic horizon is the most highly decomposed of the organic soil materials. It has the least amount of fiber, the highest bulk density, and the lowest saturated water-holding capacity. It is very stable and changes very little physically or chemically with time unless it is drained. The humic horizon has less than 10% rubbed fiber by volume and a pyrophosphate index of 3 or less.

LFH These organic horizons developed primarily from leaves, twigs, woody materials and a minor component of mosses under imperfectly to well drained forest conditions.

L This is an organic horizon characterized by an accumulation of organic matter in which the original structures are easily discernible.

F This is an organic horizon characterized by an accumulation of partly decomposed organic matter. The original structures in part are difficult to recognize. The horizon may be partly comminuted by soil fauna as in moder, or it may be a partly decomposed mat permeated by fungal hyphae as in mor.

H This is an organic horizon characterized by an accumulation of decomposed organic

matter in which the original structures are indiscernible. This material differs from the F horizon by its greater humification chiefly through the action of organisms. It is frequently intermixed with mineral grains, especially near the junction with the mineral horizon.

MASTER MINERAL HORIZONS

Mineral horizons are those that contain less than 30% organic matter by weight as specified for organic horizons.

A This is a mineral horizon or horizons formed at or near the surface in the zone of leaching or removal of materials in solution and suspension or of maximum in situ accumulation of organic matter, or both. Included are:

1. horizons in which organic matter has accumulated as a result of biological activity (Ah);
2. horizons that have been eluviated of clay, iron, aluminum, or organic matter, or all of them (Ae);
3. horizons having characteristics of 1) and 2) above but transitional to underlying B or C (AB or A and B);
4. horizons markedly disturbed by cultivation or pasture (Ap).

B This is a mineral horizon or horizons characterized by one or more of the following:

1. an enrichment in silicate clay, iron, aluminum, or humus, alone or in combination (Bt,Bf,Bfh,Bhf, and Bh);
2. a prismatic or columnar structure that exhibits pronounced coatings or stainings and significant amount of exchangeable Na (Bn);
3. an alteration by hydrolysis, reduction, or oxidation to give a change in color or structure from horizons above or below, or both, and does not meet the requirements of 1) and 2) above (Bm,Bg).

C This is a mineral horizon or horizons comparatively unaffected by the pedogenic processes operative in A and B, excepting (i) the process of gleying, and (ii) the accumulation of calcium and magnesium carbonates and more soluble salts (Cca,Csa,Cg, and C). Marl and diatomaceous earth are considered to be C horizons.

R This is consolidated bedrock that is too hard to break with the hands or to dig with a spade when moist and that does not meet the requirement of a C horizon. The boundary between the R layer and overlying unconsolidated material is called a lithic contact.

W This is a layer of water in Gleysolic, Organic, or Cryosolic soils. It is called a hydric layer in Organic soils.

LOWER-CASE SUFFIXES

b Buried soil horizon.

c A cemented (irreversible) pedogenic horizon. The ortstein of a Podzol, and a layer cemented by calcium carbonate and a duripan are examples.

ca A horizon with secondary carbonate enrichment where the concentration of lime exceeds that present in the unenriched parent material. It is more than 10 cm thick, and if it has a $CaCO_3$ equivalent of less than 15 percent it should have at least 5 percent more $CaCO_3$ equivalent than the parent material (IC). If it has more than 15 percent $CaCO_3$ equivalent it should have 1/3 more $CaCO_3$ equivalent than the IC. If no IC is present, this horizon is more than 10 cm thick and contains more than 5 percent by volume of secondary carbonates in concretions or soft, powdery forms.

cc Cemented (irreversible) pedogenic concretions.

e A horizon characterized by the eluviation of clay, iron, aluminum, or organic matter alone or in combination. When dry, it is usually higher in color value by 1 or more units than an underlying B horizon. It is used with A (Ae).

f A horizon enriched with amorphous material, principally Al and Fe combined with organic matter. It usually has a hue of 7.5YR or redder or its hue is 10YR near the upper boundary and becomes yellower with depth. When moist, the chroma is higher than 3 or the value is 3 or less. It contains 0.6% or more pyrophosphate-extractable Al+Fe in textures finer than sand and 0.4% or more in sands (coarse sand, sand, fine sand, and very fine sand). The ratio of pyrophosphate-extractable Al+Fe to clay (less than 0.002mm) is more than 0.05 and organic C exceeds 0.5%. Pyrophosphate-extractable Fe is at least 0.3%, or the ratio of organic C to pyrophosphate-extractable Fe is less than 20, or both are true. It is used with B alone (Bf), with B and h (Bhf), with B and g (Bfg), and with other suffixes. The criteria for "f" do not apply to Bgf horizons. The following horizons are differentiated on the basis of organic carbon content: Bf - 0.5% to 5% organic carbon. Bhf-more than 5% organic carbon.

g A horizon characterized by gray colors, or prominent mottling, or both, indicative of permanent or periodic intense reduction. Chromas of the matrix are generally 1 or less. It is used with A and e (Aeg); with B alone (Bg); with B and f (Bfg); with B, h, and f (Bhfg); with B and t (Btg); with C alone (Cg); with C and k (Ckg); and several others. In some reddish parent materials, matrix colors of reddish hues and high chromas may persist despite long periods of reduction. In these soils, horizons are designated as g if there is gray mottling or if there is marked bleaching on ped faces or along cracks.

Aeg This horizon must meet the definitions of A,e, and g.

Bg These horizons are analogous to Bm horizons but they have colors indicative of poor drainage and periodic reduction. They include horizons occurring between A and C horizons in which the main features are (i) colors of low chroma, that is: chromas of 1 or less, without mottles on ped surfaces or in the ma-

trix if peds are lacking; or chromas of 2 or less in hues of 10YR or redder, on ped surfaces or in the matrix if peds are lacking, accompanied by more prominent mottles than those in the C horizon; or hues bluer than 10Y, with or without mottles on ped surfaces or in the matrix if peds are lacking. (ii) colors indicated in (i) and a change in structure from that of the C horizons. (iii) color indicated in (i) and illuviation of clay too slight to meet the requirements of Bt; or accumulation or iron oxide too slight to meet the limits of Bgf. (iv) colors indicated in (i) and removal of carbonates. Bg horizons occur in some Orthic Humic Gleysols and some Orthic Gleysols.

Bfg, Bhfg, Btg, and others. When used in any of these combinations the limits set for f, hf, t, and others must be met.

Bgf The dithionite-extractable Fe of this horizon exceeds that of the IC by 1% or more. Pyrophosphate-extractable Al + Fe is less than the minimum limit specified for 'f' horizons. This horizon occurs in Fera Gleysols and Fera Humic Gleysols, and possibly below the Bfg of gleyed Podzols. It is distinguished from the Bfg of gleyed Podzols on the basis of the extractability of the Fe and Al. The Fe in the Bgf horizon is thought to have accumulated as a result of the oxidation of ferrous iron. The iron oxide formed is not associated intimately with organic matter or with Al, and it is sometimes crystalline. The Bgf horizons are usually prominently mottled, with more than half of the soil material occurring as mottles of high chroma.

Cg, Ckg, Ccag, Csg, Csag. When g is used with C alone, or with C and one of the lower-case suffixes k, ca, s, or sa, it must meet the difinition for C and for the particular suffix.

h A horizon enriched with organic matter. It is used with A alone (Ah); or with A and e (Ahe); or with B alone (Bh); or with B and f (Bhf).

Ah A horizon enriched with organic matter that either has a color value at least one unit lower than the underlying horizon or contains 0.5% more organic carbon than the IC, or both. It contains less than 17% organic carbon by weight.

Ahe An Ah horizon that has undergone eluviation as evidenced, under natural conditions, by streaks and splotches of differing shades of gray and often by platy structure. It may be overlain by a darker-colored Ah and underlain by a lighter-colored Ae.

Bh This horizon contains more than 1% organic carbon, less than 0.3% pyrophosphate-extractable Fe, and has a ratio of organic carbon to pyrophosphate-extractable Fe of 20 or more.

Generally the color value and chroma are less than 3 when moist.

Bhf Defined under 'f'.

j Used as a modifier of the suffixes e, f, g, n, and t to denote an expression of, but failure to meet, the specified limits of the suffix it modifies. It must be placed to the right and adjacent to the suffix it modifies. For example Bfgj means a Bf horizon with weak expression of gleying; Bfjgj means a B horizon with weak expression of both 'f' and 'g' features.

Aej It denotes an eluvial horizon that is thin, discontinuous or slightly discernible.

Btj It is a horizon with some illuviation of clay, but not enough to meet the limits of Bt.

Btgj, Bmgj. Horizons that are mottled but do not meet the criteria of Bg.

Bfj It is a horizon with some accumulation of pyrophosphate-extractable Al and Fe but not enough to meet the limits of Bf.

Bntj or Bnj. Horizons in which development of solonetzic B properties is evident but insufficient to meet the limits for Bn or Bnt.

k Denotes the presence of carbonate, as indicated by visible effervescence when dilute HCl is added. Most often it is used with B and m (Bmk) or C (Ck), and occasionally with Ah or Ap (Ahk, Apk), or organic horizons (Ofk, Omk).

m A horizon slightly altered by hydrolysis, oxidation, or solution, or all three, to give a change in color or structure, or both. It has:

1. Evidence of alteration in one of the following forms:

   a) Higher chromas and redder hues than the underlying horizons.

   b) Removal of carbonates, either partially (Bmk) or completely (Bm).

2. Illuviation, if evident, too slight to meet the requirements of a Bt or a podzolic B.

3. Some weatherable minerals.

4. No cementation or induration and lacks a brittle consistence when moist. This suffix can be used as Bm, Bmgj, Bmk, and Bms.

n A horizon in which the ratio of exchangeable Ca to exchangeable Na is 10 or less. It must also have the following distinctive morphological characteristics: prismatic or columnar structure, dark coatings on ped surfaces, and hard to very hard consistence when dry. It is used with B, as Bn or Bnt.

p A horizon disturbed by man's activities, such as cultivation, logging, habitation, etc. It is used with A and O.

s A horizon with salts, including gypsum, which may be detected as crystals or veins, as surface crusts of salt crystals, by depressed crop growth, or by the presence of salt-tolerant plants.

It is commonly used with C and k (Csk), but can be used with any horizon or combination of horizon and lowercase suffix.

sa A horizon with secondary enrichment of salts more soluble than calcium and magnesium carbonates, in which the concentration of salts exceeds that present in the unenriched parent material. The horizon is 10 cm or more thick. The conductivity of the saturation extract must be at least 4 ms/cm and must exceed that of the C horizon by at least one-third.

t An illuvial horizon enriched with silicate clay. It is used with B alone (Bt), with B and g (Btg), with B and n (Bnt), etc.

Bt A Bt horizon is one that contains illuvial layer-lattice clays. It forms below an eluvial horizon, but may occur at the surface of a soil that has been partially truncated. It usually has a higher ratio of fine clay to total clay than IC. It has the following properties:

1. If any part of an eluvial horizon remains and there is no lithologic discontinuity between it and the Bt horizon, the Bt horizon contains more total and fine clay than the eluvial horizons, as follows:

   a) If any part of the eluvial horizon has less than 15% total clay in the fine earth fraction (2mm) the Bt horizon must contain at least 3% more clay, e.g.,Ae 10% clay-Bt minimum 13% clay.

   b) If the eluvial horizon has more than 15% and less than 40% total clay in the fine earth fraction, the ratio of the clay in the Bt horizon to that in the eluvial horizon must be 1.2 or more, e.g., 20% clay increase in the Bt over Ae.

   c) If the eluvial horizon has more than 40% total clay in the fine earth fraction, the Bt horizon must contain at least 8% more clay than the eluvial horizon, e.g. Ae 50% clay; Bt at least 58% clay.

2. A Bt horizon must be at least 5 cm thick. In some sandy soils where clay accumulation occurs in the lamellae, the total thickness of the lamellae should be more than 10 cm in the upper 150 cm of the profile.

3. In massive soils the Bt horizon should have oriented clays in some pores and also as bridges between the sand grains.

4. If peds are present, a Bt horizon shows clay skins on some of the vertical and horizontal ped surfaces and in the fine pores, or shows oriented clays in 1% or more of the cross section, as viewed in thin section.

5. If a soil shows a lithologic discontinuity between the eluvial horizon and the Bt horizon, or if only a plow layer overlies the Bt horizon, the Bt horizon need show only clay skins in some part, either in some fine pores or on some vertical and horizontal ped surfaces. Thin sections should show that some part of the horizon has about 1% or more of oriented clay bodies.

Btj, Btj, and Btg are defined under j and g.

u A horizon that is markedly disrupted by physical or faunal processes other than cryoturbation. Evidence of marked disruption such as the inclusion of material from other horizons, absence of the horizon, etc. must be evident in at least half of the cross section of the pedon. Such turbation can result from blowdown of trees, mass movement of soil on slopes, and burrowing animals. It can be used with any horizon or subhorizon with the exception of A or B alone; e.g. Aeu, Bfu, BCu.

x A horizon of fragipan character. A fragipan is a loamy subsurface horizon of high bulk density and very low organic matter content. When dry, it has a hard consistence and seems to be cemented. When moist, it has moderate to weak brittleness. It frequently has bleached fracture planes and is overlain by a friable B horizon. Air dry clods of fragic horizons slake in water.

y A horizon affected by cryoturbation as manifested by disrupted and broken horizons,, incorporation of materials from other horizons and mechanical sorting in at least half of the cross section of the pedon. It is used with A, B, and C alone or in combination with other subscripts, e.g. Ahy, Ahgy, Bmy, Cy, Cgy, Cygj, etc.

z A frozen layer. It may be used with any horizon or layer, e.g. Ohz, Bmz, Cz, Wz.

Appendix C

DESCRIPTION OF LANDFORMS

C.1 GENETIC MATERIALS

Unconsolidated mineral component

The unconsolidated mineral component consists of clastic sediments that may or may not be stratified, but whose particles are not cemented together. They are essentially of glacial or post-glacial origin but include poorly consolidated and weathered bedrock.

Anthropogenic - Man-made or man-modified materials, including those associated with mineral exploitation and waste disposal.

Colluvial - Massive to moderately well stratified, nonsorted to poorly sorted sediments with any range of particle sizes from clay to boulders and blocks that have reached their present position by direct, gravity-induced movement.

They are restricted to products of mass-wasting whereby the debris is not carried by wind, water, or ice (excepting snow avalanches).

Eolian - Sediment, generally consisting of medium to fine sand and coarse silt particle sizes, that is well sorted, poorly compacted, and may show internal structures such as cross bedding or ripple laminae, or may be massive. Individual grains may be rounded and show signs of frosting.

These materials have been transported and deposited by wind action.

Fluvial - Sediment generally consisting of gravel and sand with a minor fraction of silt and clay. The gravels are typically rounded and contain interstitial sand. Fluvial sediments are commonly moderately to well sorted and display stratification, but massive, nonsorted fluvial gravels do occur. These materials have been transported and deposited by streams and rivers. Finer textured Fluvial deposits of modern rivers are termed Alluvium.

Lacustrine - Sediment generally consisting of either stratified fine sand, silt, and clay deposited on the lake bed; or moderately well sorted and stratified sand and coarser materials that are beach and other nearshore sediments transported and deposited by wave action.

These are materials that either have settled from suspension in bodies of standing fresh water or have accumulated at their margins through wave action.

Marine - Unconsolidated deposits of clay, silt, sand, or gravel that are well to moderately well sorted and well stratified to moderately stratified (in some places containing shells). They have settled from suspension in salt or brackish water bodies or have

accumulated at their margins through shoreline processes such as wave action and longshore drift.

Morainal - Sediment generally consisting of well compacted material that is nonstratified and contains a heterogeneous mixture of particle sizes, often in a mixture of sand, silt, and clay that has been transported beneath, beside, on, within and in front of a glacier and not modified by any intermediate agent.

Saprolite - Rock containing a high proportion of residual silts and clays formed by alteration, chiefly by chemical weathering.

The rock remains in a coherent state, interstitial grain relationships are undisturbed and no downhill movement due to gravity has occurred.

Undifferentiated - A layered sequence of more than three types of genetic material outcropping on a steep erosional escarpment.

Volcanic - Unconsolidated pyroclastic sediments. These include volcanic dust, ash, cinders, and pumice.

Qualifying Descriptors

These have been introduced to qualify the genetic materials and to supply additional information about the mode of formation or depositional environment.

Glacial - Used to qualify nonglacial genetic materials or process modifiers where there is direct evidence that glacier ice exerted a strong but secondary or indirect control upon the mode of origin of the materials or mode of operation of the process. The use of this qualifying descriptor implies that glacier ice was close to the site of the deposition of a material or the site of operation of a process.

Glaciofluvial - Fluvial materials showing clear evidence of having been deposited either directly in front of or in contact with glacier ice.

Glaciolacustrine - Lacustrine materials deposited in contact with glacial ice.

Glaciomarine - Materials of glacial origin laid down in a marine environment, as a result of settling from melting, floating ice and ice shelves.

Organic component

The organic component consists of peat deposits containing >30% organic matter by weight that may be as thin as 10 cm if they overlie bedrock but are otherwise greater than 40 cm and generally greater than 60 cm thick. The classes and their definitions follow.

B	Bog
N	Fen
S	Swamp

Bog - A bog is a peat-covered or peat-filled area, generally with a high water table. Since the surface of the peatland is slightly elevated, bogs are either unaffected or partly affected by nutrient-rich groundwaters from the surrounding mineral soils. The groundwater is generally acidic and low in nutrients (ombrotrophic). The dominant peat materials are sphagnum and forest peat, underlain, at times, by fen peat.

Fen - A fen is a peat-covered or peat-filled area with a high water table, which is usually at the surface. The dominant materials are shallow to deep, well to moderately decomposed fen peat. The waters are mainly rich in nutrients (minerotrophic) and are derived from mineral soils. The peat materials are therefore higher in both nutrients and pH than the peats associated with bogs.

Swamp - A swamp is a peat-covered or peat-filled area. The peat surface is level or slightly concave in cross section. The water table is frequently at or above the peat surface. There is strong water movement from margins or other mineral sources. The microrelief is hummocky, with many pools present. The waters are neutral or slightly acid. The dominant peat materials are shallow to deep mesic to humic forest and fen peat.

C.2 GENETIC MATERIAL MODIFIERS

Material modifiers are used to qualify unconsolidated mineral and organic deposits. Particle-size classes serve to indicate the size, roundness, and sorting of unconsolidated mineral deposits. Fiber classes indicate the degree of decomposition and fiber size of organic materials.

Particle size classes for unconsolidated mineral materials

Blocky: An accumulation of angular particles greater than 256 mm in size.

Bouldery: An accumulation of rounded particles greater than 256 mm in size.

Clayey: An accumulation of particles where the fine earth fraction contains 35% or more clay (<0.002 mm) by weight and particles greater than 2 mm are less than 35% by volume.

Cobbly: An accumulation of rounded particles having a diameter of 64-256 mm.

Gravelly: An accumulation of rounded particles ranging in size from pebbles to boulders.

Loamy: An accumulation of particles of which fine earth fraction contains 35% or less clay (<0.002 mm) by weight and particles greater than 2 mm are less than 35% by volume.

Pebbly: An accumulation of rounded particles having a diameter of 2-64 mm.

Rubbly: An accumulation of angular fragments having a diameter of 2-256 mm.

Sandy: An accumulation of particles of which the fine earth fraction contains more than 70% by weight of fine sand or coarser particles. Particles greater than 2 mm occupy less than 35% by volume.

Silty: An accumulation of particles of which the fine earth fraction contains less than 15% of fine sand or coarser particles and has less than 35% clay. Particles greater than 2 mm occupy less than 35% by volume.

Fiber classes for organic materials

The amount of fiber and its durability are important characterizing features of organic deposits in that they reflect on the degree of decomposition of the material. The prevalence of woody materials in peats is also of prime importance.

Fibric: The least decomposed of all organic materials; there is a large amount of well-preserved fiber that is readily identifiable as to botanical origin. Fibers retain their character upon rubbing.

Mesic: Organic material in an intermediate stage of decompostion; intermediate amounts of fiber are present that can be identified as to their botanical origin.

Humic: Highly decomposed organic material; small amounts of fiber are present that can be identified as to their botanical origin. Fibers can be easily destroyed by rubbing.

Woody: Organic material containing more than 50% of woody fibers.

C.3 SURFACE EXPRESSION

The surface expression of genetic materials is their form (assemblage of slopes) and pattern of forms. Form as applied to unconsolidated deposits refers specifically to the product of the initial mode of origin of the materials. When applied to consolidated materials, form refers to the product of their modification by geological processes. Surface expression also indicates the manner in which unconsolidated genetic materials relate to the underlying unit.

Consolidated and Unconsolidated mineral surface classes

Apron - A relatively gentle slope at the foot of a steeper slope and formed by materials from the steeper, upper slope.

Blanket - A mantle of unconsolidated materials thick enough to mask minor irregularities in the underlying unit but still conforming to the general underlying topography.

Fan - A fan-shaped form similar to the segment of a cone and having a perceptible gradient from the apex to the toe.

Hummocky - A very complex sequence of slopes extending from somewhat rounded depressions or kettles of various sizes to irregular to conical knolls or knobs. There is a general lack of concordance between knolls or depressions. Slopes are generally 9-70% (5-35 degrees).

Inclined - A sloping, unidirectional surface with a generally constant slope not broken by marked irregularities. Slopes are 2-70% (1-35 degrees). The form of inclined slopes is not related to the initial mode of origin of the underlying material.

Level - A flat or very gently sloping, unidirectional surface with a generally constant slope not broken by marked elevations and depressions. Slopes are generally less than 2% (1 degree).

Rolling - A very regular sequence of moderate slopes extending from rounded, sometimes confined concave depressions to broad, rounded convexities producing a wave-lake pattern of moderate relief. Slope length is often 1.6 km or

greater and gradients are greater than 5% (3 degrees).

Ridged - A long, narrow elevation of the surface, usually sharp crested with steep sides. The ridges may be parallel, subparallel, or intersecting.

Steep - Erosional slopes, greater than 70% (35 degrees), on both consolidated and unconsolidated materials. The form of a steep erosional slope on unconsolidated materials is not related to the initial mode of origin of the underlying material.

Terraced - Scarp face and the horizontal or gently inclined surface (tread) above it.

Undulating - A very regular sequence of gentle slopes that extends from rounded, sometimes confined concavities to broad rounded convexities producing a wavelike pattern of low local relief. Slope length is generally less than 0.8 km and the dominant gradient of slopes is 2-5% (1-3 degrees).

Veneer - Unconsolidated materials too thin to mask the minor irregularities of the underlying unit surface. A veneer will range from 10 cm to 1 m in thickness and will possess no form typical of the material's genesis.

Organic surface classes

Blanket - A mantle of organic materials that is thick enough to mask minor irregularities in the underlying unit but still conforms to the general underlying topography.

Bowl - A bog or fen occupying concave-shaped depressions.

Domed - A bog with an elevated, convex, central area much higher than the margin. Domes may be abrupt (with or without a frozen core) or gently sloping or have a stepped surface.

Floating - A level organic surface associated with a pond or lake and not anchored to the lake bottom.

Horizontal - A flat peat surface not broken by marked elevations and depressions.

Plateau - A bog with an elevated, flat, central area only slightly higher than the margin.

Ribbed - A pattern of parallel or reticulate low ridges associated with fens.

Sloping - A peat surface with a generally constant slope not broken by marked irregularities.

Veneer - A thin (40 cm-1m) mantle of organic materials which generally conforms to the underlying topography. They may or may not be associated with discontinuous permafrost.

Appendix D

CORRELATION OF THE SOILS IN THE AREAS OF GREY, DUFFERIN, ROLAND, THOMPSON AND STANLEY MUNICIPALITIES OF SOUTH-CENTRAL MANITOBA

The resurvey of the Municipalities of Grey, Dufferin, Roland, Thompson and western part of Stanley provides more detailed soil information than the 1936-37 survey of South Central Manitoba (published 1943) and the respective areas of the Winnipeg-Morris Report 1953. The area below the Manitoba Escarpment was resurveyed at a scale of 1:20,000, similar to the eastern portion of Stanley (Morden-Winkler report 1973), and the area above the Escarpment at 1:50,000; the resurvey benefits from more intensive examination of the soils in the field and the use of larger scale map to permit the delineation of local soils, which was not possible in the original 1:125,000 scale reconnaissance map.

The reconnaissance soil survey employed broadly defined soil groupings called "Soil Associations" consisting of related but unlike soils that occur in a characteristic pattern on similar parent material. These related soils called "soil associates" occupy different positions in the landscape and differ in profile characteristics because of local influences of topography, drainage and vegetation. Individual soils associates can occupy complex patterns with other associates.

In the 1:20,000 and 1:50,000 scale resurvey, "soil series" a conceptual soil grouping approximate equivalent to "soil associates" in the reconnaissance soil survey, is used as the basic map unit component, and as a map delineation lable. The labels on the present maps differ from the Morden-Winkler map since three letter codes for the series names have been adopted and direct symbols for erosion, slope class, stoniness and salinity were added when it was appropriate. A comparison of the soil series used in the current resurvey area with associations, soil associates and phases used in the South-Central, Winnipeg-Morris and Carberry reports is present in Table 15. A correlation is also provided in Table 16 for the soil symbol and phases in the Morden-Winkler Report to enable direct comparison of the map units in the D60 resurvey map of Roland and Thompson Municipalities.

TABLE 15

Correlation of the Soils in the areas of Grey, Dufferin, Roland, Thompson and Stanley Municipalities of South-Central Manitoba

Map Symbol		Soil Name	Subgroup	Soil Association	Soil Association and Associates of the South-Central, Carberry, Winnipeg-Morris Sheets.
D60	Morden-Winkler				
ARN		Aronet	Cumulic Regosol	Almasippi	Almasippi, thick overblown member.
ASS		Almasippi	Gleyed Rego Black	Almasippi	Almasippi, imperfectly drained Meadow-Prairie soil or Black-Meadow associate.
ASZ		Agassiz	Orthic Black	Agassiz	Agassiz, well drained Blackearth or Black.
ATN		Altamont	Orthic Dark Gray	Altamont	Altamont, well drained Gray-Black.
BEO		Benton	Solonetzic Dark Gray	Benton	Benton, alkalized soil in weathered shale.
BIP		Bishop	Gleyed Rego Black	Benton	Benton, Meadow-Black member.
BKA	Ba	Birkenhead	Calcareous Black	Agassiz	Agassiz, Calcareous Blackearth-like.
BKA		Basker	Rego Humic Gleysol	Levine	Neelin, (Assiniboine Complex) poorly drained on recent alluvium.
BMG	Bd	Blumengart	Gleyed Cumulic Regosol	Blumengart	Morden and Gretna, inmature soil on clay textured materials. Soils mapped as Elias(Ef) in M-W are included with BMG.
BNF	Bb	Blumenfeld	Rego Humic Gleysol	Gnadenthal	Altona fine loam, Meadow associate.
BNI		Brundis	Orthic Black	Brundis	Benton, Blackearth associate.
BOX		Boxner	Rego Humic Gleysol	Roseisle	Blumenstein Complex, Meadow associate on fine loams on waterworked till.
BUM	Be	Blumenort	Rego Humic Gleysol	Blumengart	Morden and Gretna, Meadow associate.
CAV		Carvey	Rego Humic Gleysol	Croyon	Agassiz, Blumenstein Complex, Marringhurst or Heaslip Complex, Meadow on fine loams over coarse sands and gravel.
CTZ	Ca	Chortitz	Gleyed Cumulic Regosol	Chortitz	Morden immature, Meadow soils on dominantly recent deposits.
CXT		Capell	Gleyed Rego Black	Croyon	Agassiz, loam overlay, Blumenstein Complex, Marringhurst, loam overlay; Heaslip Complex, fine loams over coarse sand and gravel; intermediately drained Meadow-Blackearth associate.
CYN		Croyon	Orthic Black	Croyon	Agassiz, Blumenstein Complex, Marringhurst, and Heaslip Complex, Blackearth, fine loam over coarse sand and gravel.
CZK		Cazlake	Rego Humic Gleysol	Darlingford	Darlingford, Meadow associate.
DGF		Darlingford	Orthic Black	Darlingford	Darlingford, well drained Blackearth associate.
DGS	Df	Dugas	Gleyed Rego Black	Jordan	Morden, shallow phase, thin clay sediments over sands, Meadow-Blackearth associate.
DHO	Da	Deadhorse	Gleyed Rego Black	Winkler	Morden, Meadow-Blackearth associate.

Table 15 cont.

Map Symbol		Soil Name	Subgroup	Soil Association	Soil Association and Associates of the South-Central, Carberry, Winnipeg-Morris Sheets
D60	Morden-Winkler				
DNH		Denham	Orthic Black	Denham	Altona fine loam, heavy substrate, Blackearth associate.
DOB		Dobbin	Orthic Black	Dobbin	Firdale-Stockton transition; fine sand to loamy fine sand, well drained Degraded Black associate of the Firdale Association (Carberry Report).
DXM		Druxman	Gleyed Black	Croyon	Agassiz and Marringhurst, imperfectly drained Blackearth, fine loams over sand and gravel deposits.
DXT		Dexter	Gleyed Black	Marringhurst	Marringhurst, imperfectly drained Blackearth on sands and gravels.
DZW		Dezwood	Orthic Dark Gray	Dezwood	Pembina, well drained Gray-Black associate.
EBG	Ed	Edenburg	Orthic Black	Edenburg	Altona fine loam or Morden shallow phase underlain by sands; Blackearth.
EDK		Edkins	Rego Humic Gleysol	Denham	Altona fine loams, heavy subsoil, Meadow associate.
EEK		Elm Creek	Gleyed Black	Hibsin	Altona light loams, heavy subsoil or Almasippi, sands, and loamy sands clay substrate; imperfectly drained Blackearth or Black-Meadow associate.
EGF	Ec	Eigenhof	Orthic Black	Eigenhof	Morden fine loams, Altona fine loams, Blackearth associate or Rathwell, Degrading Black associate.
ERX		Eroded Slopes Complex	variable		Truncated Chernozemic, Luvisolic and Regosolic soils found on steep sloping, dissected terrain and valley, sidewalls along the Manitoba Escarpment and Pembina River.
FFR		Fifere	Orthic Dark Gary	Fifere	Snowflake or Manitou, Gray-Black associate on dominantly shaly till.
FRS		Ferris	Gleyed Rego Black	Darlingford	Darlingford, Meadow-Blackearth associate.
FSO		Fresno	Gleyed Dark Gray	Fifere	Snowflake or Manitou, Gray Black, phytohydromorphic associate on dominantly shaly till.
FTE		Fortier	Gleyed Cumulic Regosol	Fortier	Riverdale, immature, dominantly clay textured member on recent alluvium; Oakville Association in the Carberry map sheet.
FTN		Fortina	Rego Humic Gleysol	Marringhurst	Marringhurst, Meadow associate.
FWK		Froswick	Orthic Black	Froswick	Benton, Blackearth, thin till over shale bedrock.
GCS	Gg	Glencross	Gleyed Rego Black	Roseisle	Blumenstein Complex, Meadow-Blackearth on fine loams on waterworked till.
GDH	Ga	Gnadenthal	Gleyed Rego Black	Gnadenthal	Altona fine loams, Meadow-Blackearth associate.
GRA		Gretna	Gleyed Solonetzic Black	Gretna	Gretna, alkalinized Blackearth associate.
GRR		Guerra	Rego Humic Gleysol	Knudson	Altamont, Snowflake, some Manitou; Meadow associate.

Table 15 cont.

Map Symbol		Soil Name	Subgroup	Soil Association	Soil Association and Associates of the South-Central, Carberry, Winnipeg-Morris Sheets.
D60	Morden-Winkler				
GVS		Gervais	Gleyed Bumulic Regosol	La Salle	Riverdale, intermediately drained on recent alluvium.
GYV	Gf	Graysville	Gleyed Rego Black	Denham	Altona fine loams, heavy subsoil, Meadow-Blackearth associate.
HHF	Hb	Hochfeld	Orthic Black	Hochfeld	Altona light loam, moderately well drained Blackearth; Almasippi sandy loam, Blackearth.
HIN	Hj	Hibsin (Hobson)	Orthic Black	Hibsin	Altona light loam, moderately well drained heavy subphase; Almasippi sandy loam, heavy subphase phytohydromorphic Blackearth; soil called Hobson in M-W report.
HND	He	Horndean	Gleyed Black	Jordon	Morden, shallow phase, sand substrate intermediately drained Blackearth.
HOS		Horose	Rego Humic Gleysol	Dezwood	Pembina, Meadow and calcareous, Meadow associate.
JIS		Jirose	Gleyed Rego Black	Froswick	Benton, shallow till over shale, Meadow-Blackearth associate.
JOD	Ja	Jordan	Orthic Black	Jordan	Morden, shallow phase sand substrate, Blackearth.
JST		Jasset	Gleyed Black	Neuenberg	Altona light loam to fine loam transition sandy substrates; imperfectly drained Blackearth. (minor areas of Gleyed Black soils were included with Rosengart in M-W.
JYL		Joyale	Gleyed Rego Black	Knudson	Altamont, Snowflake, some Manitou; imperfectly drained Meadow-Blackearth.
KDA		Klidal	Gleyed Solonetzic Black	Benton	Benton, imperfectly drained alkalinized gray-black.
KIS		Kingsley	Dark Gray Luvisol	Altamont	Altamont, well drained gray associate.
KOT		Kronstal	Gleyed Black	Hochfeld	Altona light loam and Almasippi sandy loam, imperfectly drained Blackearth; areas of Gleyed Black soils were included with Hochfeld series in M-W.
KRN		Kerran	Rego Humic Gleysol	Assiniboine	Neelin, Assiniboine Complex, poorly drained immature soils, clayey textured recent alluvium.
KUD		Knudson	Orthic Black	Knudson	Altamont and Snowflake, Blackearth.
LAY		Layland	Rego Humic Gleysol	Hibsin	Altona light loam, heavy substrate or Almasippi sandy loam heavy substrate, poorly drained Meadow or calcareous Meadow.
LEI		Levine	Gleyed Cumulic Regosol	Levine	Neelin (Assiniboine Complex) immature soils, intermediately drained on recent alluvium.
LEW		Loewen	Gleyed Cumulic Regosol	Chortitz	Morden, immature soils on fine loam, poorly drained; these were not differentiated in the Chortitz areas in M-W.

Table 15 cont.

Map Symbol		Soil Name	Subgroup	Soil Association	Soil Association and Associates of the South-Central, Carberry, Winnipeg-Morris Sheets.
D60	Morden-Winkler				
LLT		Lelant	Rego Humic Gleysol	Almasippi	Almasippi, Meadow and Calcareous Meadow associate.
LOP		Long Plain	Gleyed Regosol	Almasippi	Almasippi sands, intermediately drained, (leached) Wooded member.
LRY		Leary	Orthic Dark Gray	Leary	Leary, Gray Wooded and Gray-Black soils.
LSL		LaSalle	Cumulic Regosol	LaSalle	Riverdale, immature soils on recent terrace and flood plain.
MFI		Mansfield	Gleyed Rego Black	Marringhurst	Marringhurst, intermediately drained Meadow-Blackearth.
MHC		Marsh Complex	-	-	Waterlogged, miscellaneous land.
MOW		Mowbray	Cumulic Regosol	Levine	Neelin, Assiniboine Complex, loamy immature soils on moderately well drained terraces.
MRH		Marringhurst	Calcareous Black	Marringhurst	Marringhurst, Blackearth-like.
MRS	Mo	Morris	Gleyed Solonetzic Black	Red River	Red River:-Solonetzic Black-Meadow associate (Carberry): intermediately drained alkalized associate (South-Central); alkalinized (Winnipeg-Morris).
MXS		Manitou	Orthic Black	Manitou	Manitou, Blackearth on shaly till.
MYT		Myrtle	Orthic Black	Red River	Myrtle clay better drained associate.
NBG	Na Nb Nc	Neuenberg	Gleyed Rego Black	Neuenberg	Altona light loam - fine loam transition, intermediately drained Meadow-Blackearth.
NKK		Nikkel	Gleyed Black	Darlingford	Darlingford, intermediately drained Blackearth.
NOW		Nowell	Gleyed Black	Manitou	Manitou, intermediately drained Blackearth.
NTO		Nanton	Gleyed Black	Roseisle	Blumenstein Complex, intermediately drained, Blackearth on fine loams over water-worked till.
NUH	Ne	Neuhorst	Gleyed Rego Black	Eigenhof	Altona fine loams, intermediately drained Meadow-Blackearth.
NWN	Nj	Newton Siding	Gleyed Rego Black	Edenburg	Morden fine loams, shallow phase with sand substrate, intermediately drained Meadow-Blackearth.
OAY		Oakley	Orthic Dark Gray	Froswick	Benton, Manitou/shale, Pembina/shale; Gray-Black soil on shallow calcareous till over shale bedrock.

Table 15 cont.

Map Symbol		Soil Name	Subgroup	Soil Association	Soil Association and Associates of the South-Central, Carberry, Winnipeg-Morris Sheets.
D60	Morden-Winkler				
OBO	Oc	Osborne	Rego Humic Gleysol	Red River	Red River, Meadow or Calcareous Meadow.
OWK	Oa	Osterwick	Rego Humic Gleysol	Hochfeld	Altona light loam, Meadow or Calcareous Meadow.
PBI		Pembina	Dark Gray Luvisol	Pembina	Pembina, Gray associate.
PER		Perillo	Terric Mesisol	Perillo	Orgniac, shallow peat and muck soils.
PGK		Pigeon Lake	Gleyed Cumulic Regosol	Pigeon Lake	Riverdale, immature soil, recent terrace and flood plain (fine loams overlying clay substrate.
PME	Pa	Plum Coulee	Gleyed Black	Winkler	Morden, intermediately drained Blackearth.
POU		Pouchal	Humic Luvic Gleysol	Pembina	Pembina poorly drained Swamp Podzolic soils, degraded.
PPR		Poplar Point	Gleyed Cumulic Regosol	La Salle	Riverdale, imperfectly drained, immature soil, recent terrace and flood plain, fin loams.
PYR		Poyser	Orthic Gray Luvisol	Poyser	Pembina, Gray Wooded associate.
RBK	Rj	Rosebank	Gleyed Rego Black	Hibsin	Altona light loam, heavy substrates or Almasippi sandy loam heavy substrate Meadow-Blackearth associate.
RFD	Re	Reinfeld	Orthic Black	Gnadenthal	Altona fine loams, Blackearth associate.
RGD	Rg	Rignold	Gleyed Black	Denham	Altona fine loams, heavy subphase, intermediately drained Blackearth associate.
RIV	Rr	Red River	Gleyed Rego Black	Red River	Red River, intermediately drained Blackearth-like (included with Myrtle in the South-Central map area).
RLD	Ra	Reinland	Gleyed Rego Black	Hochfeld	Altona light loam, intermediately drainedMeadow-Blackearth associate.
RSG	Rm	Rosengart	Orthic Black	Neuenberg	Altona light loam to fine loam transition Blackearth associate.
RSI	Rh	Roseisle	Orthic Black	Roseisle	Blumenstein Complex, fine loams over water modified till; Blackearth associate.
RWL		Rathwell	Gleyed Black	Eigenhof	Altona fine loams, intermediately drained Blackearth-Meadow associate.
SCK		Stockton	Orthic Black	Stockton	Stockton sand and loamy sand, Blackearth-like associate.
SCY		Scanterbury	Gleyed Black	Red River	Included with the Myrtle, better drained Blackearth associate.
SKL		Skelding	Orthic Regosol	Almasippi	Sand Dunes with weak profile development.
SQR		Squirrel Creek	Gleyed Rego Black	Hibsin	Almasippi sandy loam, heavy substrate, Meadow-Prairie soils Calcareous associate.

Table 15 cont.

Map Symbol		Soil Name	Subgroup	Soil Association	Soil Association and Associates of the South-Central, Carberry, Winnipeg-Morris Sheets.
D60	Morden-Winkler				
SUE		St. Claude	Gleyed Rego Black	Almasippi	Almasippi sandy loam, Meadow-Prairie soils Calcareous associate.
SXG		Stallar	Orthic Regosol	Stallar	Shale outcrop, thin loose or modified shale (or possibly till over shale bedrock).
TDW		Tredwell	Rego Humic Gleysol	Eroded Slopes Complex	Eroded Slopes Complex - poorly drained areas receiving fluvial material and colluvium.
TLI		Tellier	Gleyed Dark Gray	Altamont	Altamont, Snowflake; shallow loam to clay deposits over till, intermediately drained Gray-Black associate.
TNT		Trinton	Dark Gray Luvisol	Trinton	Blumenstein Complex, Leary; sandy loam overlay on sand and gravel; well drained Gray Wooded associate.
ULH		Ullrich	Gleyed Black	Knudson	Altamont-Darlingford transition; loam to clay deposit over till; intermediately drained Blackearth.
VDL		Vandal	Orthic Dark Gray	Vandal	Blumenstein Complex, Leary; sandy loam overlay on sand and gravel; gray-Black associate.
VTL		Vartel	Gleyed Dark Gray	Vandal	Blumenstein Complex, Leary; sandy loam to loam overlay over sand and gravel; intermediately drained Gray-Black associate.
WTI		Watrine	Humic Luvic Gleysol	Altamont	Altamont, Snowflake; shallow loam to clay deposits over till; poorly drained Swamp Podzolic soils, degraded.
WIK	Wa	Winkler	Orthic Black	Winkler	Morden, Blackearth associate.
WIK2		Winkler heavy clay, substrate variant	Orthic Black	Winkler	Gretna, Blackearth Wooded associate.
WOR		Worden	Orthic Regosol	Darlingford	Darlingford, Blackearth knolls, eroded.
WWB		Willowbend	Rego Humic Gleysol	LaSalle	Riverdale, Eroded Slopes Complex, poorly drained (Meadow) soils along channels and flood plain.
WWC		Willowcrest	Gleyed Black	Almasippi	Almasippi sands, light fine sandy loams, Gray-Black to Meadow-Prairie.
XVI		Xavier	Typic Mesisol	Xavier	Organic, peat and muck soils.
YTK		Yustak	Rego Humic Gleysol	Vandal	Blumenstein Complex, Hecla Complex, Agassiz, Marringhurst, poorly drained, fine loams over sand and gravel, Meadow or Calcareous Meadow.

Table 15 cont.

Map Symbol		Soil Name	Subgroup	Soil Association	Soil Association and Associates of the South-Central, Carberry, Winnipeg-Morris Sheets.
D60	Morden-Winkler				
ZIM		Zinman	Gleyed Solonetzic Dark Gray	Altamont	Imperfectly drained alkalinized associates of the Altamont, Snowflake and Manitou Associations.
ZPI		Zaplin	Gleyed Dark Gray	Dezwood	Pembina, intermediately drained Gray Black to Gray Wooded associate.

TABLE 16

Correlation of the Morden-Winkler Soil Series and Phases with the Soil Symbols and Phase Notations in Report D60

Map Symbol	Soil Name	Surface Texture	Phase	Equivalent Symbol and phase notation in D60
Ba	Birkenhead	Loamy sand		BKA
Bb	Blumenfeld	Loam		BNF
Bd	Blumengart	Clay		BMG
Be	Blumenort	Clay		BUM
Ca1	Chortitz	Loam		CTZ
Ca2	Chortitz	Loam	Gently undulating	CTZ/xcxx
Da	Deadhorse	Clay		DHO
Db	Deadhorse	Clay	Slightly saline	DHO/xxxs
Dc	Deadhorse	Clay loam		DHO1
Dd	Deadhorse	Clay loam	Slightly saline	DHO1/xxxs
De	Deadhorse	Loam		DHO1
Df	Dugas	Clay		DGS
Dg	Dugas	Clay	Slightly saline	DGS/xxxs
Dc	Deadhorse	Clay loam		DHO1
Dd	Deadhorse	Clay loam	Slightly saline	DHO1/xxxs
De	Deadhorse	Loam		DHO1
Df	Dugas	Clay		DGS
Dg	Dugas	Clay	Slightly saline	DGS/xxxs
Dh	Dugas	Clay loam		DGS1
Dk	Dugas	Loam		DGS1, GYV (depending on depth)
Dl	Dugas	Loam	Slightly saline	DGS1/xxxs
Ec	Eigenhoff	Clay loam		EGF
Ed	Edenburg	Clay loam		EBG
Ef	Elias	Clay		BMG
Ga	Gnadenthal	Loam		GDH
Gb	Gnadenthal	Loam	Slightly saline	GDH/xxxs
Gc	Gnadenthal	Clay loam		GDH or NUH
Gd	Gnadenthal	Clay		NUH or DGS
Gf	Graysville	Loam		GYV
Gg	Glencross	Loam		GCS
HB	Hochfeld	Fine sandy loam		HHF
Hc	Hochfeld	Fine sandy loam	Eroded	HHF/1xxx
Hd	Hochfeld	Fine sandy loam	Overblown	HHF/oxxx
He	Horndean	Clay		HND
Hf	Horndean	Clay loam		HND1
Hh	Horndean	Loam		RGD or HND1(depending on depth)
Hj	Hobson	Fine sandy loam		HIN (name changed to Hibsin)

Table 16 cont.

Map Symbol	Soil Name	Surface Texture	Phase	Equivalent Symbol and phase notation in D60
Hk	Huddlestone	Loamy fine sand	moderately to very stony	HDT/xx3x (inclusions with RSI/xx3x)
Ja	Jordan	Clay		JOD
Jb	Jordan	Clay loam		JOD1
Mo	Morris	Clay		MRS
Na	Neuenberg	Very fine sandy loam		NBG
Nc	Neuenberg	Loam		NBG
Ne	Neuhorst	Clay loam		NUH
Nf	Neuhorst	Clay loam	Slightly saline	NUH/xxxs
Ng	Neuhorst	Loam		NUH or GDH
Nh	Neuhorst	Clay		NUH or DGS (depending on depth)
Nj	Newton Siding	Clay loam		NWN
Nk	Newton Siding	Clay loam	Slightly saline	NWN/xxxs
Nl	Newton Siding	Clay		NWN1
Nm	Newton Siding	Clay	Slightly saline	NWN1/xxxs
Oa	Osterwick	Fine sandy loam		OWK
Oc	Osborne	Clay		OBO
Pa	Plum Coulee	Clay		PME
Pb	Plum Coulee	Clay loam		PME1 (or RGD if CL is thick)
Pc	Plum Coulee	Loam		PME1 (or RGD if loam is thick)
Ra	Reinland	Fine sandy loam		RLD
Rb	Reinland	Fine sandy loam	Eroded	RLD/2xxx
Rc	Reinland	Fine sandy loam	Overblown	RLD/oxxx
Rd	Reinland	Fine sandy loam		RLD
Re	Reinfeld	Loam		RFD
Rg	Rignold	Loam		RGD
Rh	Roseisle	Loam		RSI
Ri	Roseisle	Loam	Moderately to very stony	RSI/xx2x RSI/xx3x RSI/xx4x
Rj	Rosebank	Fine sandy loam		RBK
Rm	Rosengart	Loam		RSG
Rn	Rosengart	Very fine sandy loam		RSG
Rr	Red River	Clay		RIV
Wa	Winkler	Clay		WIK
Wb	Winkler	Clay loam		WIK1
Wc	Winkler	Loam		WIK1 or DNH if loam is thick

Appendix E

GENERALIZED SOIL MAP

This section contains the generalized soil map for each municipality, and a brief description of the soil groups. Schematic diagrams showing soil distribution within selected landscapes are included. The generalized map and description provides an overview of the soil distribution and the landscapes in the map area. Each map unit consists of a natural landscape with a distinct pattern of soils relief and drainage features. Each map unit typically consists of one or more soils of major extent and some soils of minor extent. The map units are named according to the dominant and significant soil series identified in the area on the detailed soil map. Minor components of compound map units and soil inclusions are not recognized on the generalized soil map.

The generalized soil map provides a basis for comparing the potential of large areas for general kinds of land use. This information is useful for broad-scale planning, and for identifying areas suitable for certain kinds of farming or other land uses. Similarly, areas of soils with properties that are distinctly unfavourable for certain land uses can be located.

The generalized soil map, because of its small scale does not show the kind of soil at a specific site. Therefore, it is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other kind of infrastructure. The kinds of soils in any one map unit ordinarily differ from place to place in slope, depth, stoniness, drainage or other characteristic that affect their management.

A brief description of each generalized soil group follows. The format established for the Morden-Winkler report was followed for the area below the Escarpment.

1. RIV-SCY-MRS-OBO

   The Red River-Scanterbury-Morris Osborne group consists of Gleyed Rego Black, Gleyed Solonetzic Black and Rego Humic Gleysols developed on deep, moderately to strongly calcareous fine to very fine clayey lacustrine sediments. They occur on the north eastern portion of Stanley municipality, and eastern part of Roland, Dufferin and Grey municipalities. Soil drainage ranges from poor to imperfect; the Osborne areas have had considerable improvement in drainage and large drainage networks are common. The agricultural capability is 2W and 3W. Larger areas of dominantly Osborne soils have been separated on the map and designated as 1a.

2. WIK-JOD

   The Winkler-Jordon group consists of dominantly Orthic Black soils developed on stratified, moderately to strongly

calcareous, fine textured fluvial and lacustrine sediments. They occur along the better drained levees of the streams below the Escarpment and some interbeach areas along the Escarpment. The agricultural capability is considered as Class 1.

3. DHO-PME-DGS

Deadhorse - Plum Coulee - Dugas group consists of Gleyed Rego Black and Gleyed Black soils on moderately to strongly calcareous fine textured fluvial sediments. The agricultural capability is mainly 2W.

4. DHO/xxxs-DGS/xxxs

Deadhorse-Dugas, weakly saline group have soils similar to Group 3 and sufficient soluble salts present to affect crop growth. The agricultural capability is 3N.

5. BMG-BUM-GRA

Blumengart-Blumenort-Gretna group consist of Gleyed Cumulic Regosol, Rego Humic Gleysol and Gleyed Solonetzic Black soils on fine textured shaly fluvial and lacustrine sediments including recent depositional areas. These areas may have appreciable salts. It includes areas of Solonetzic soils with sufficient sodium content to cause a hard columnar to hard massive structure when dry. A general diagram of the landscape, soils and parent materials in this group is presented in Figure 9.

6. EGF-EBG-RSG

Eigenhof-Edenburg-Rosengart group consists of Orthic Black soils developed on moderately to strongly calcareous, medium to moderately fine textured fluvial and lacustrine sediments. It includes the Reinfeld soils (Roseisle soils formerly included in this group, have been placed in 14). The agricultural capability is Class 1.

7. GDH-NBG-NUH

Gnadenthal-Neuenberg-Neuhorst group consists of Gleyed Rego Black soils developed on moderately to strongly calcareous, medium to moderately fine fluvial and lacustrine sediments. It includes Newton Siding and Blumenfeld series. The agricultural capability is dominantly Class 1, with inclusions of 2W and 3W.

8. GDH/xxxs-NUH/xxxs

Gnadenthal-Neuhorst weakly saline group with soil properties similar to group 7 but have appreciable soluble salts present to affect crop growth. This group includes Newton Siding saline phase and Blumenfeld saline phase. The agricultural capability is 3N; moderately saline areas are placed in Class 4N.

9. GYV-RGD-DNH

Graysville-Rignold-Denham group consists of Gleyed Rego Black, Gleyed Black and Orthic Black soils developed on medium to moderately fine textured sedments overlying fine textured lacustrine sediments.

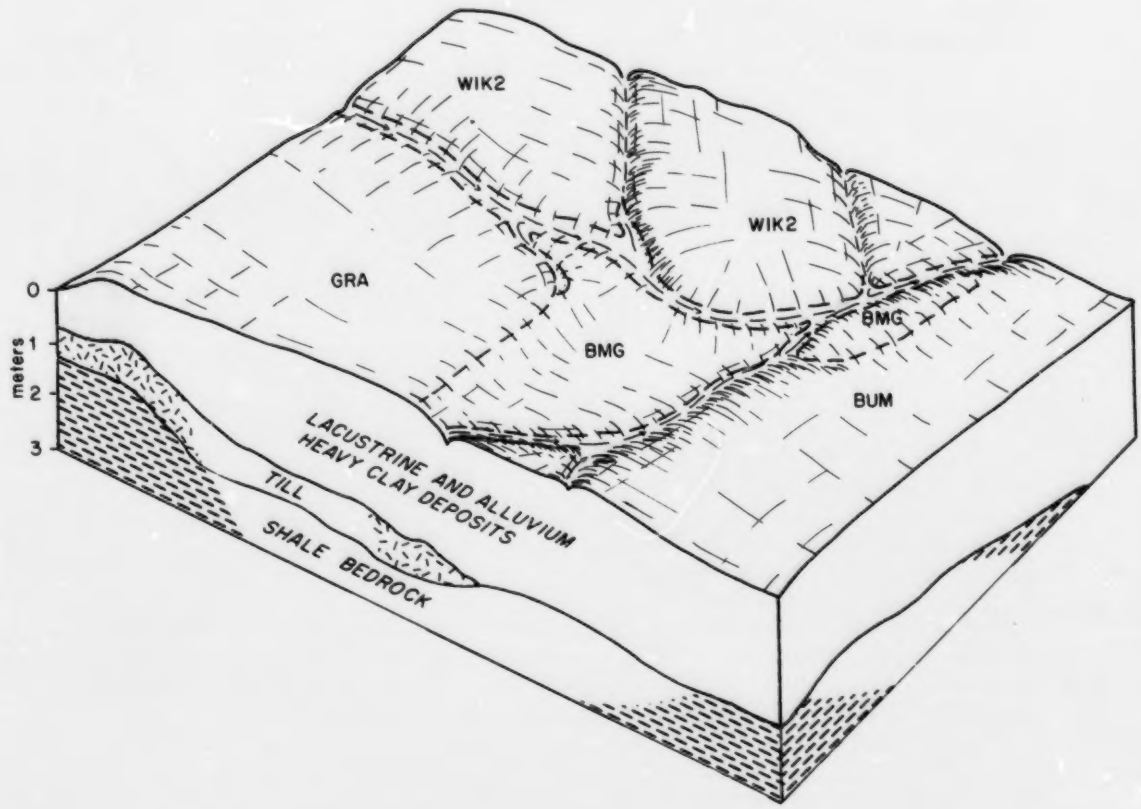


Figure 9: General diagram of the landscape, soils and parent materials of the Blumengart-Blumenort-Gretna group.

They occur in transition areas adjacent to Group 1; some inclusions of Group 1 may be present. The agricultural capability ranges from Class 1 to 2W.

10. HHF-KOT

Hochfeld-Kronstal group consists of Orthic Black and Gleyed Black soils developed on moderately coarse to coarse textured fluvial and lacustrine sediments. They occur generally above the Emerado Beach in Roland Stanley and Thompson Municipalities and some localized areas below the Beach. The agricultural capability ranges from 2M to 3M depending on the soil drainage and depth of seasonal water table.

11. RLD

Reinland group consists of Gleyed Rego Black soils developed on moderately calcareous, moderately coarse to coarse textured lacustrine sediments. They occur mainly above the Emerado Beach in the Roland, Stanley and Thompson municipalities and in areas transitional to the Almasippi soils in Dufferin and Grey municipalities. The agricultural capability is dominantly 2M.

12. CTZ-GVS

Chortitz, Gervais group consists of dominantly Gleyed Cumulic Regosol soils developed on moderately to strongly calcareous, stratified, moderately fine to coarse textured recent alluvium. Group 12a refers to the Chortitz and Loewen soils which have sediments derived from the Escarpment and Pembina Hills area. The agricultural capability varies from 2I to 4I or 4W depending on severity of flooding and ponding severity. Group 12b includes the Gervais, La Salle, and Willowbend soils on sediments from the Boyne, La Salle and Assiniboine Rivers. The agricultural capability varies from Class 1 to 4I or 4W depending on topographic position, flooding and ponding problems.

13. ASZ-BKA-LRY

The Agassiz-Birkenhead-Leary group consists of Orthic Black, Calcareous Black and Orthic Dark Gray soils developed on sandy and gravelly coarse textured, moderately to strongly calcareous beach and outwash deposits. It includes soils on shallow medium textured sediments over sand and gravel such as Croyon, Vandal, Vartel and Trinton. The agricultural capability is Class 5M; soils with shallow loamy overlays may be classified as 3M or 4M depending on depth and texture of the overlay. A general diagram of the landscape and soils in this group is presented in Figure 10.

14. GCS-RSI

Glencross-Roseisle group consists of Gleyed Rego Black and Orthic Black soils developed on moderately fine textured fluvial and lacustrine sediments overlying medium to moderately fine textured glacial till. They occur mainly in the Escarpment area in Stanley and Thompson municipalities. Agricultural capability ranges from 2X or 2W to 5P depending on degree of stoniness.

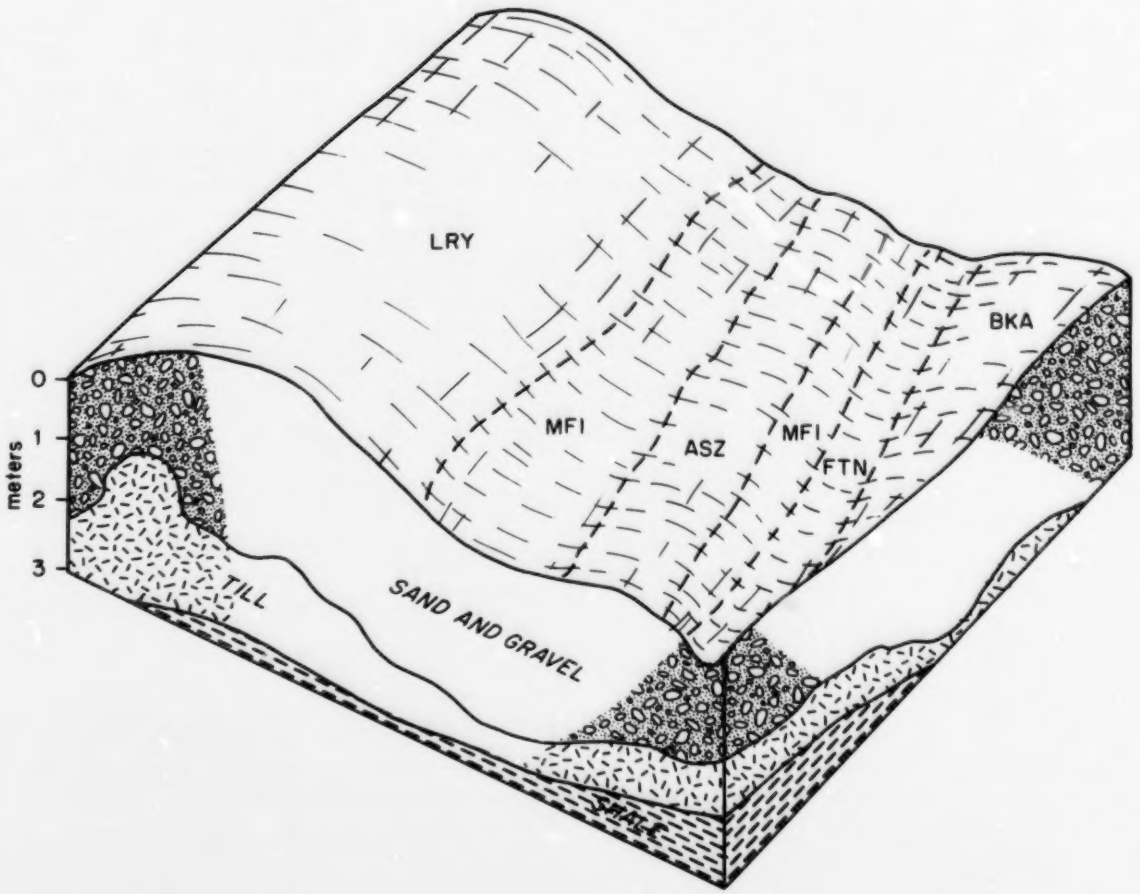


Figure 10: General diagram of the landscape, soils and parent materials of the Agassiz-Birkenhead-Leary group.

15. ASS-LLT-LOP-SKL-SUE-WWC

The Almasippi soils have been considered as one group to reflect a range of soil types on sandy fluvial, lacustrine and aeolian sediments and deposits. Several subdivisions of this broad group have been made to convey the dominant soil type and relative drainage. They occur in the western part of Dufferin and Grey municipalities. A general diagram of the various soils of the Almasippi Association is presented in Figure 11, to illustrate the general relationship of soils to topographic position and water table; this complex condition in the landscape has been simplified into groups representing the dominant and subdominant soil occurrence. The groups are as follows:

15a. ASS-SUE-LTT

Almasippi - St. Claude - Lelant group consists of the Gleyed Rego Black soils with minor areas of Rego Humic Gleysol. The Almasippi soil is weakly to moderately calcareous while the St. Claude soil is very strongly calcareous in the upper 45 to 60 cm. The agricultural capability is Class 2 due to droughtiness (M) or wetness (W). The soils are suceptible to wind erosion if adequate surface cover is not provided.

15b. ASS-WWC-LOP

Almasippi-Willowcrest-Long Plain group consists of the Gleyed Rego Black and Gleyed Black soils with minor areas of Gleyed Regosols These areas have been influenced by wind erosion and are more susceptible to wind erosion than soils of group 15a. The agriculture capability would be 3M.

15c. WWC-LOP

Willowcrest-Long Plain group consists of the Gleyed Black and Gleyed Regosol soils. These areas are susceptible to wind erosion if adequate surface cover is not provided; much of this area has been previously affected by wind erosion. The agricultural capability ranges from class 3ME to 4EM.

15d. SKL-LOP

Skelding-Long Plain group consists of Orthic Regosol and Gleyed Regosol soils that have been influenced by considerable aeolian modification (dune topography). Most of this area is in native pasture and unproductive woodland; some areas have been cultivated for crops and improved pasture or hayland. The soils are very susceptible to wind erosion if left exposed for short periods of time. Agricultural capability ranges from 5M to 7MT, depending on slope class in the duned areas.

15e. LLT-LLTp-SUE

Lelant-Lelant, peaty phase - St. Claude group consists of a dominance of Rego Humic Gleysol with subdominance of Gleyed Rego Black, very strongly calcareous soils. Drainage of the landscape is poor with areas of ponded conditions for part of the year. Agricultural capability is mainly 6W; land use is mainly native grazing or pasture.

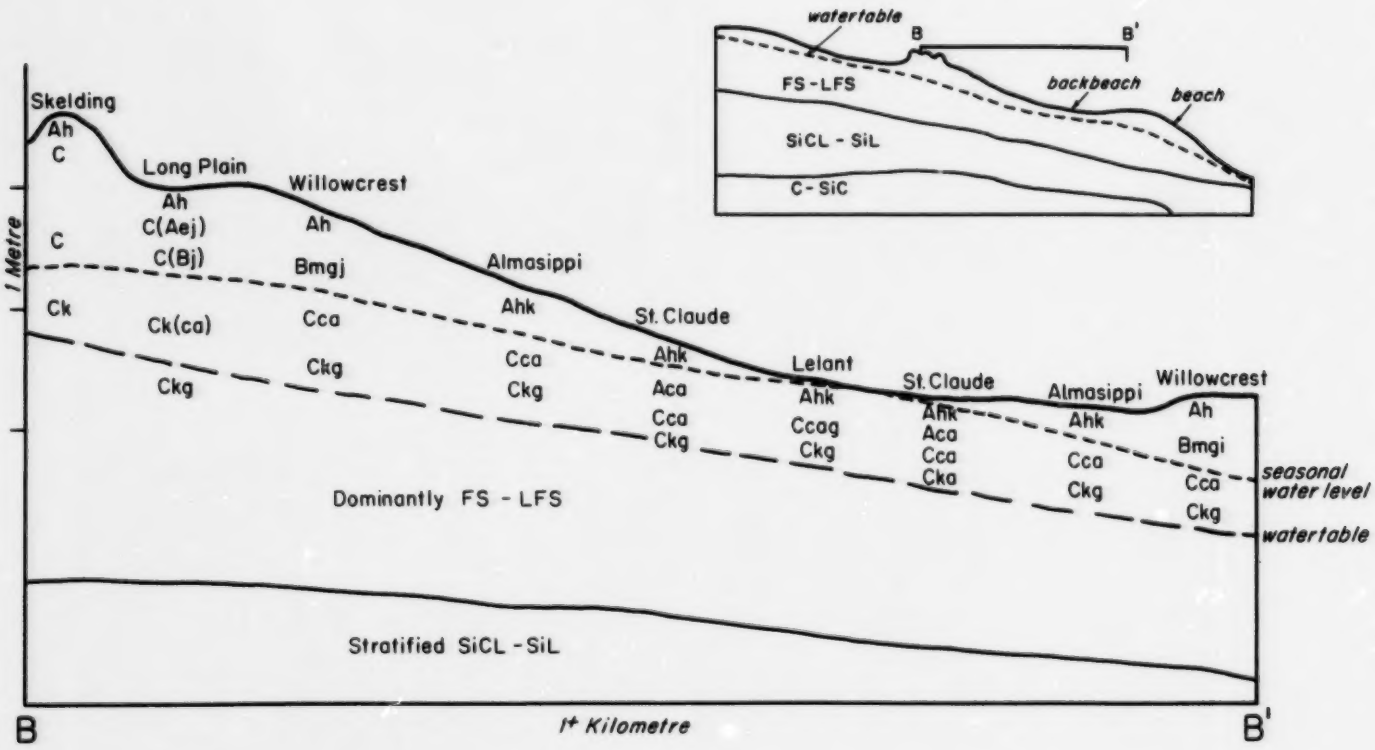


Figure 11: General diagram of the Soil Series of Almasippi Association as influenced by slope position and water table.

15f. LOP_1-LLTp-SKL_1

The Long Plain, medium sand variant-Lelant, peaty and Skelding, medium sand variant constitute a group of soils with undulating and hummocky topography; the soils complex consists of Gleyed Regosols, Rego Humic Gleysols and Orthic Regosols. The better drained soils are very susceptible to wind erosion if left unprotected. Land use is mainly native grazing with some areas of improved hay or pasture. Agricultural capability is 5M, 6W and 6 or 7T depending on drainage and topography.

16. PER

Perillo group consists of shallow organic soils (Terric Mesisols) overlying dominantly sandy sediments or substrate variants; this group also includes areas of peaty phases of the Lelant series. The agricultural capability is considered 03W following adequate drainage. Associated peaty soils are in class 6W in the native state, and 4W if drained.

17. DGF-DZW-PBI

Darlingford-Dezwood-Pembina group includes Black, Dark Gray and Dark Gray Luvisol soils developed on moderately to strongly calcareous glacial till of mixed granitic, limestone and shale composition. This group has been subdivided into four groups to reflect dominant soils, drainage, and topography.

17a. DZW-PBI

Level to gently sloping Dezwood and Pembina consisting of Dark Gray Luvisol soils generally above 460 m a.s.l. These areas have undulating to hummocky topography with slopes commonly less than 3 percent. The knoll positions of cultivated soils have slight erosion by wind and water. Gleyed Dark Gray or Gleyed Dark Luvisols occur on the lower slopes, and Luvic Gleysol in the depressional areas. The agricultural capability varies from 2X to 3T depending on topography. A general diagram of the landscape, soils and parent materials of this group is presented in Figure 12.

17b. DZW-PBI

Dezwood-Pembina, moderately to strongly sloping phase is dominantly hummocky with slopes commonly between 3 to 9 percent, and local areas of steeper slopes. The knoll and upper slopes positions of cultivated soils have had moderate to severe erosion by wind and water. The agricultural capability various from 3T to 5T depending on the slope class and degree of erosion.

17c. DGF

Darlingford, level to gently sloping group consists of dominantly Orthic Black soils or complexes of Rego Black (Hebbot), Gleyed Black (Nikkel), Gleyed Rego Black (Ferris) and Rego Humic Gleysol (Cazlake) soils. Localized areas of the Altamont group are included Agricultural capability class is considered as 2X.

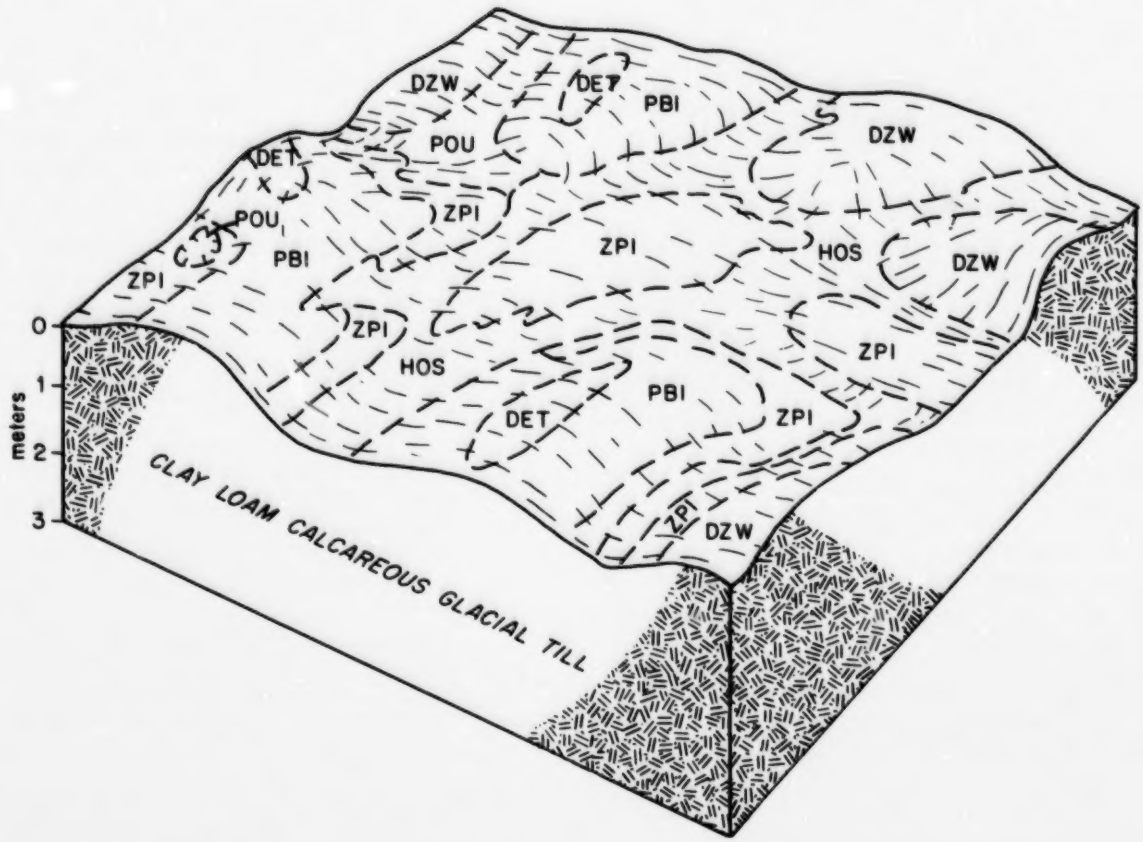


Figure 12: General diagram of the landscape, soils and parent materials of the Dezwood, Pembina group.

17d. DGF

Darlingford, moderately to strongly sloping phase has hummocky topography with slopes commonly betwen 3 to 9 percent and local areas of steeper slopes. The knolls and upper slope positions of cultivated have moderate to severe erosion by wind and water. The agricultural capability varies from Class 3T to 5T depending on slope class and degree of erosion.

18. ATN

The Altamont group includes Orthic Dark Gray soils developed on shallow moderately to strongly calcareous moderately fine textured lacustrine sediments overlying glacial till. This group has been subdivided into:

18a. ATN-TLI

Altamont-Tellier group consist of Orthic Dark Gray and Gleyed Dark Gray soils in gently sloping to gently undulating landscapes. Minor areas of Rego Humic Gleysol (occur) mainly along the drainage ways. Agricultural capability Class is 1 to 2W or 2X with localized areas of 5W. A general diagram of the landscape and soils of this group is presented in Figure 13.

18b. ATN-ZIM-GRR

Altamont-Zinman-Guerra group consist of Orthic Dark Gray, Gleyed Solonetzic Dark Gray and Rego Humic Gleysol soils; soluble salts are common in the subsoil, particularly in the Zinman soils and associated Rego Humic Gleysol Guerra soils. Sufficient sodium is present in the Zinman soils for the formation of strong columnar structure. The agriculture capability Class 2X and 3D with localized areas of 4WN and 5WN.

ERX

The Eroded Slopes complex occurs in strongly dissected landscapes and consists of steeply sloping channels and drainageways in the lower slopes of the Pembina Hills and the Escarpment area. Minor areas of alluvial soils occur on the bottom lands. Agricultural capability Class is 6T.

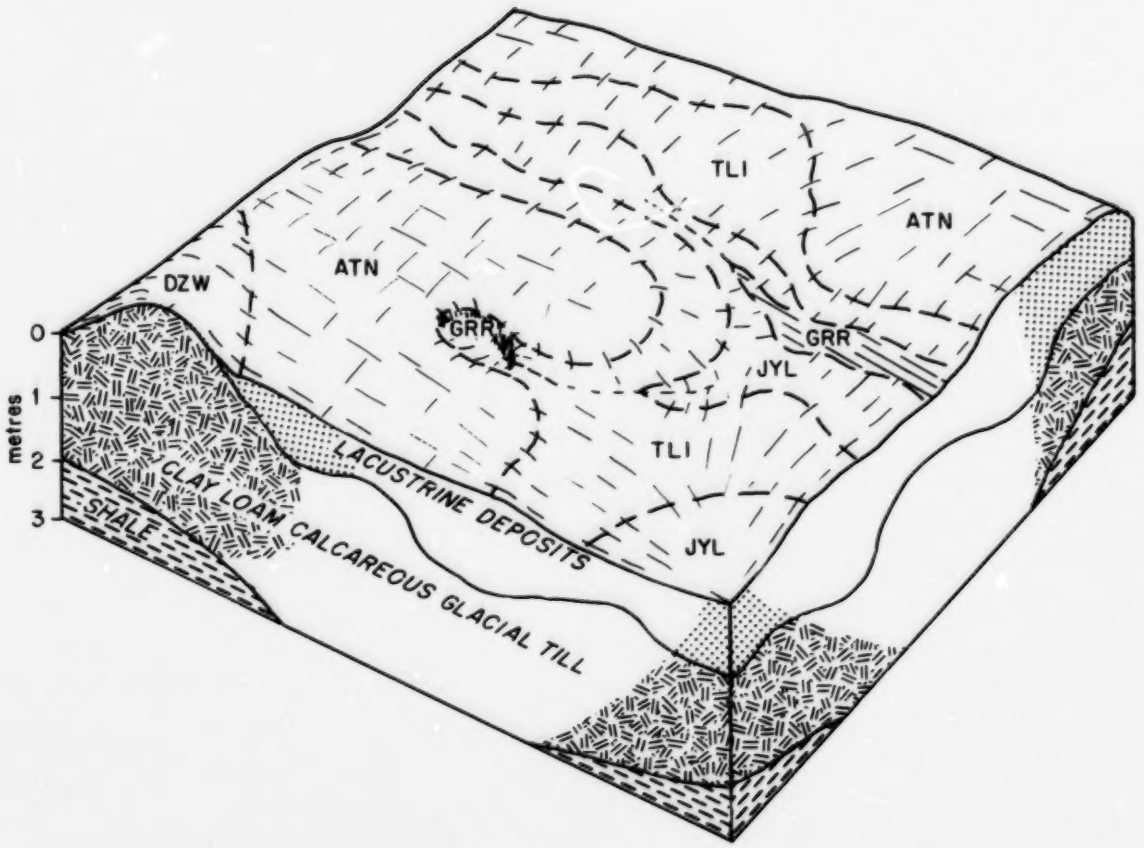


Figure 13: General diagram of the landscape, soils and parent materials of the Altamont-Tellier group.

LEGEND FOR GENERALIZED SOIL MAPS

(figures 14 to 18)

1 RIV-SCY-MRS-OBO: Red River-Scanterbury-Morris-Osborne group. GLR.BL, GL.BL, GLSZ.BL, R.HG soils on deep, fine textured lacustrine sediments (larger areas of dominantly Osborne soils have been separated as 1a)

- a OBO: Osborne soils; dominantly areas of R.HG soils, usually with improved drainage.

2 WIK-JOD: Winkler-Jordan group. O.BL soils on stratified fine textured fluvial and lacustrine sediments.

3 DHO-PME-DGS: Deadhorse-Plum Coulee-Dugas group. GLR.BL and GL.BL soils on stratified fine textured fluvial and lacustrine sediments.

4 DHO-DGS-/xxxs: Deadhorse-Dugas, weakly saline group.

5 BMG-GRA: Blumengart-Gretna group. GLCU.R and GLSZ.BL soils on fine textured shaly alluvium; includes areas of saline phases.

6 EGF-EBG-RSG: Eigenhof-Edenburg-Rosengart group. O.BL soils on medium to moderately fine textured lacustrine sediments (includes Reinfeld-RFD soils).

7 GDH-NBG-NUH: Gnadenthal-Neuenberg-Neuhorst group. GLR.BL, carbonated soils on medium to moderately fine textured lacustrine sediments (includes Newton Siding-NWN soils).

8 GDH-NUH/xxxs: Gnadenthal-Neuhorst, weakly saline group, includes Newton Siding saline phase.

9 GYV-RGD-DNH: Graysville-Rignold-Denham group. GLR.BL, GL.BL, O.BL soils on thin medium to moderately fine sediments overlying fine textured lacustrine sediments (includes Rosebank-RBK Elm Creek-EEK, and Hibsin-HIN soils).

10 HHF-KOT: Hochfeld-Kronstal group. O.BL and GL.BL soils on moderately coarse to coarse textured lacustrine sediments.

11 RLD: Reinland group. GLR.BL soils on moderately coarse to coarse textured sediments (includes Almasippi ASS and St. Claude SUE soils in transition areas).

12 CTZ-GVS: Chortitz-Gervais group. Medium to moderately fine fluvial sediments.

- a CTZ: On alluvium from shales and tills of the Escarpment (includes the Loewen-LEW soils).
- b GVS: On alluvium from Boyne and Assiniboine River sediments (includes La Salle-LSL, Willowbend-WWB soils).

13 BKA-ASZ-LRY: Birkenhead-Agassiz-Leary group. CA.BL, O.BL, O.DG soils on sandy and gravelly coarse textured beach and outwash deposits. Includes soils with thin overlay of loamy sediments such as Vandal-VDL, Vartel-VTL.

14 GCS-RSI: Glencross-Roseisle group. GLR.BL and O.BL soils on thin medium to moderately fine textured lacustrine overlay on glacial till of mixed composition.

15 ASS-LLT-LOP-SKL-SUE-WWC: Almasippi Association; range of soil types on sandy fluvial, lacustrine and aeolian sediments. They are subdivided to reflect soil drainage and relative topography.

- a ASS-SUE-LLT: Almasippi-St. Claude-Lelant group. GLR.BL and R.HG soils.
- b ASS-WWC-LOP: Almasippi-Willowcrest-Long Plain group. GLR.BL, GL.BL and GL.R soils; generally the Willowcrest is dominant and the others subdominant.
- c WWC-LOP: Willowcrest-Long Plain group. GL.BL and GL.R soils. Areas where LOP is dominant or the LOP is subdominant with WWC.
- d SKL-LOP: Skelding-Long Plain group. O.R, Gl.R soil. Areas with complex hummocky topography including dunes.
- e LLT-LLTp-SUE: Lelant-Lelant peat St. Claude group. R.HG and GLR.BL strongly carbonated soils. Areas with poor drainage dominantly.
- f LOP_1-LLTp-SKL_1: Long Plain, medium sand variant-Lelant peaty-Skelding medium sand variant. GL.R, R.HG, O.R soils on sandy deposits with considerable medium sand in the subsoil.

16 PER - Perillo group. T.M soils with organic deposits over the mineral sediments. Poorly to very poorly drained areas. Includes Lelant peaty or Xavier soils.

17 DGF-DZW-PBI: Darlingford-Dezwood-Pembina Associations. This is a broad group of soils in the Pembina Uplands on dominantly glacial till deposits; it is subdivided into 4 groups to reflect dominant soils, drainage and topography.

- a DZW-PBI: Dezwood-Pembina group. Level to gently sloping O.DG and D.GL soils with minor GL.DG and GLD.GL.
- b DZW-PBI: Dezwood-Pembina group. Moderately to strongly sloping.
- c DGF: Darlingford group. Level to gently sloping O.BL soils with areas of GL.BL and GLR.BL.
- d DGF: Darlingford, moderately to strongly sloping.

18 ATN: Altamont Association. Soils are dominantly O.DG on shallow moderately fine textured lacustrine sediments over glacial till.

- a ATN-TLI: Altamont-Tellier group. O.DG and GL.DG in gently sloping to undulating landscapes.
- b ATN-ZIM-GRR: Altamont-Zinman-Guerra group. O.DG, GLSZ.DG, R.HG soils; saline conditions are common.

ERX Eroded Slopes complex; strongly dissected landscapes.

O.BL	Orthic Black	O.DG	Orthic Dark Gray	R.HG	Rego Humic Gleysol
CA.BL	Calcareous Black	GL.DG	Gleyed Dark Gray	O.R	Orthic Regosol
GL.BL	Gleyed Black	GLSZ.DG	Gleyed Solonetzic Dark Gray	GL.R	Gleyed Regosol
GLR.BL	Gleyed Rego Black	D.GL	Dark Gray Luvisol	GLCU.R	Gleyed Cumulic Regosol
GLSZ.BL	Gleyed Solonetzic Black	GLD.GL	Gleyed Dark Gray Luvisol	T.M	Terric Mesisol

FIGURE 14 GENERALIZED SOIL MAP OF DUFFERIN R. M.

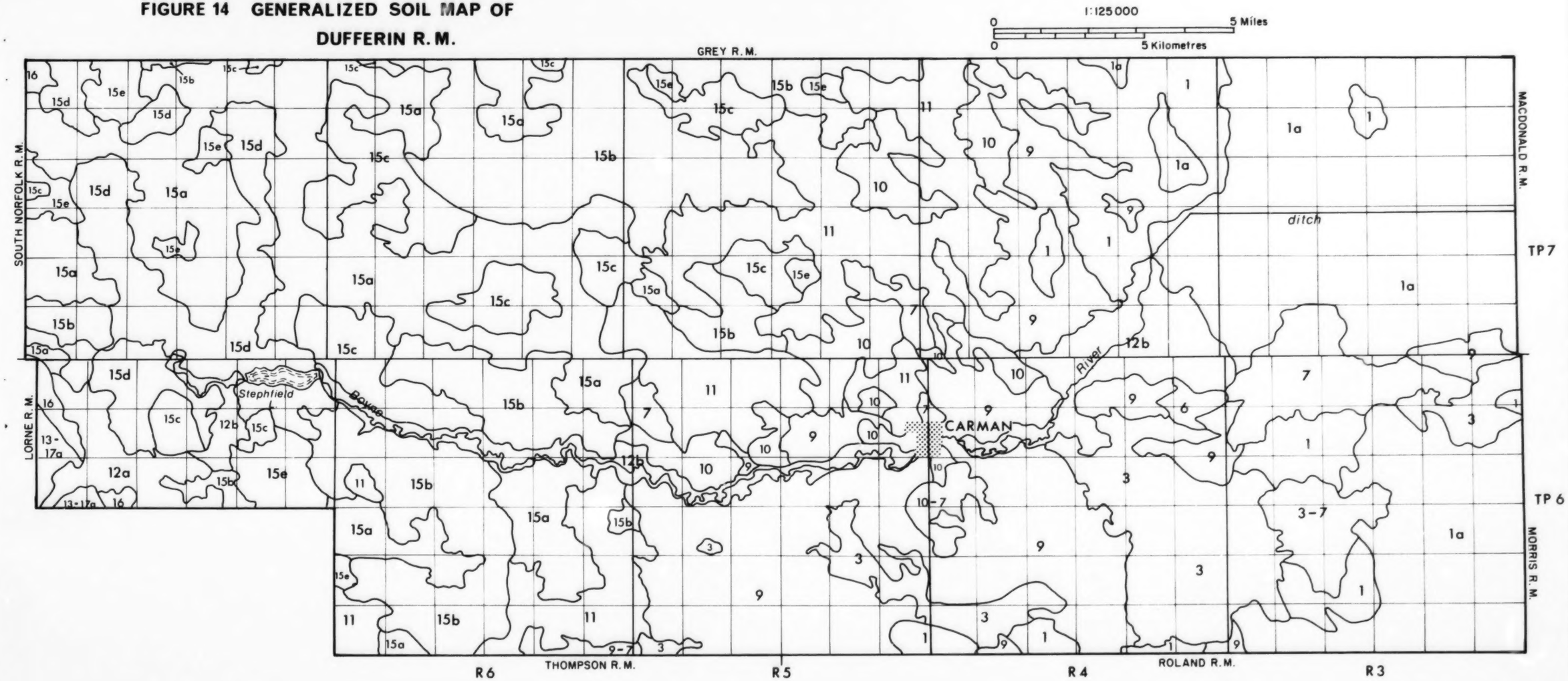


FIGURE 15 GENERALIZED SOIL MAP OF GREY R.M.

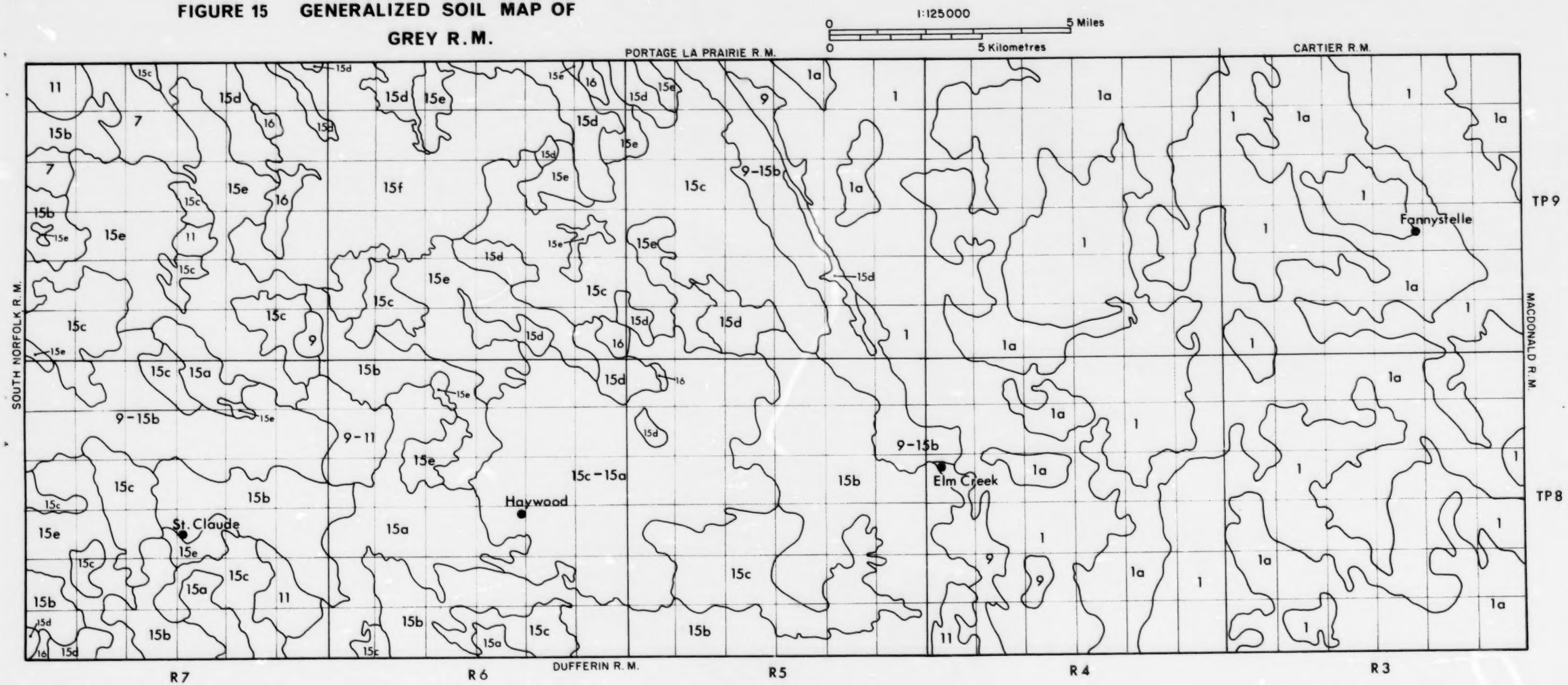
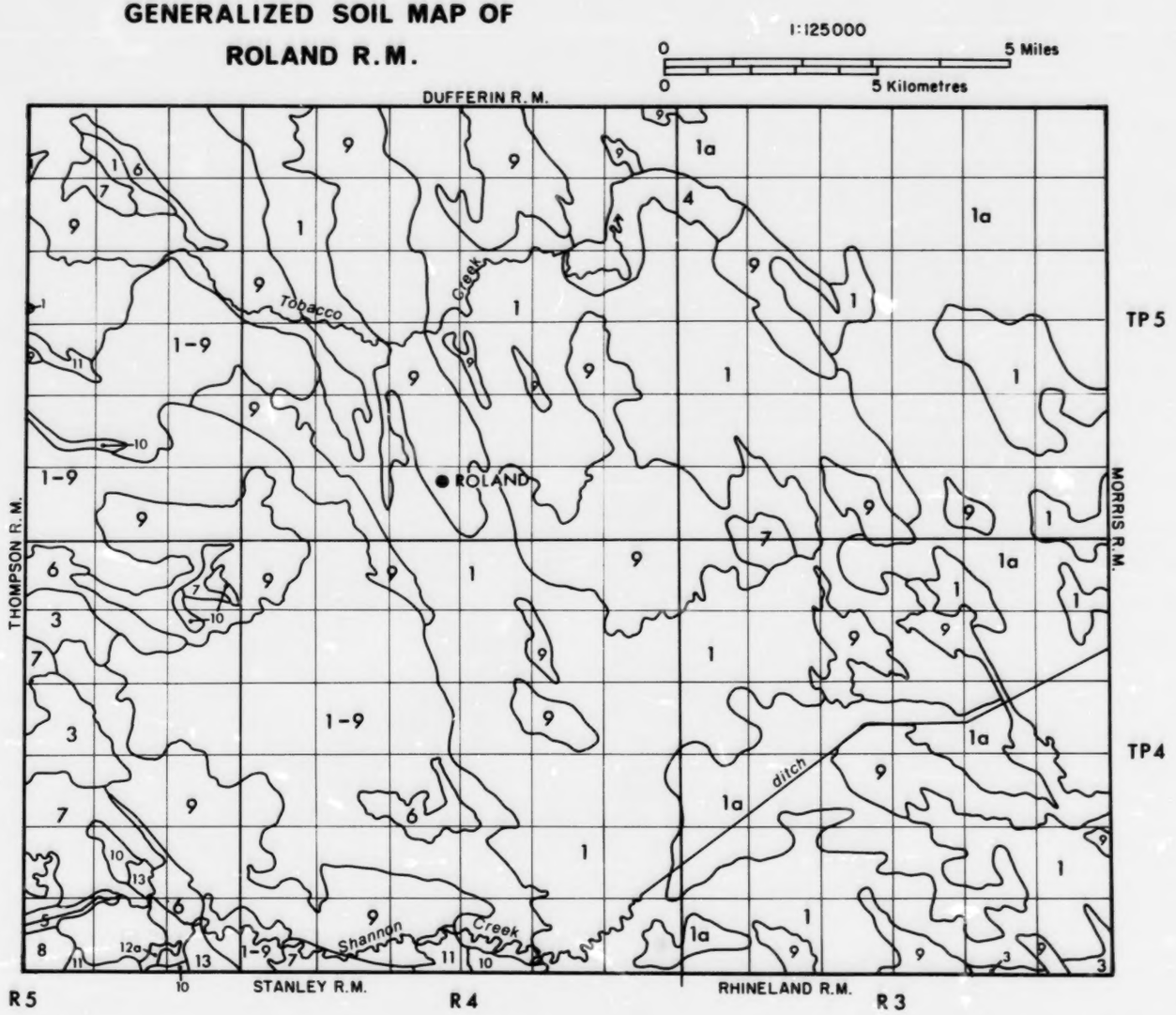


FIGURE 16
GENERALIZED SOIL MAP OF
ROLAND R.M.



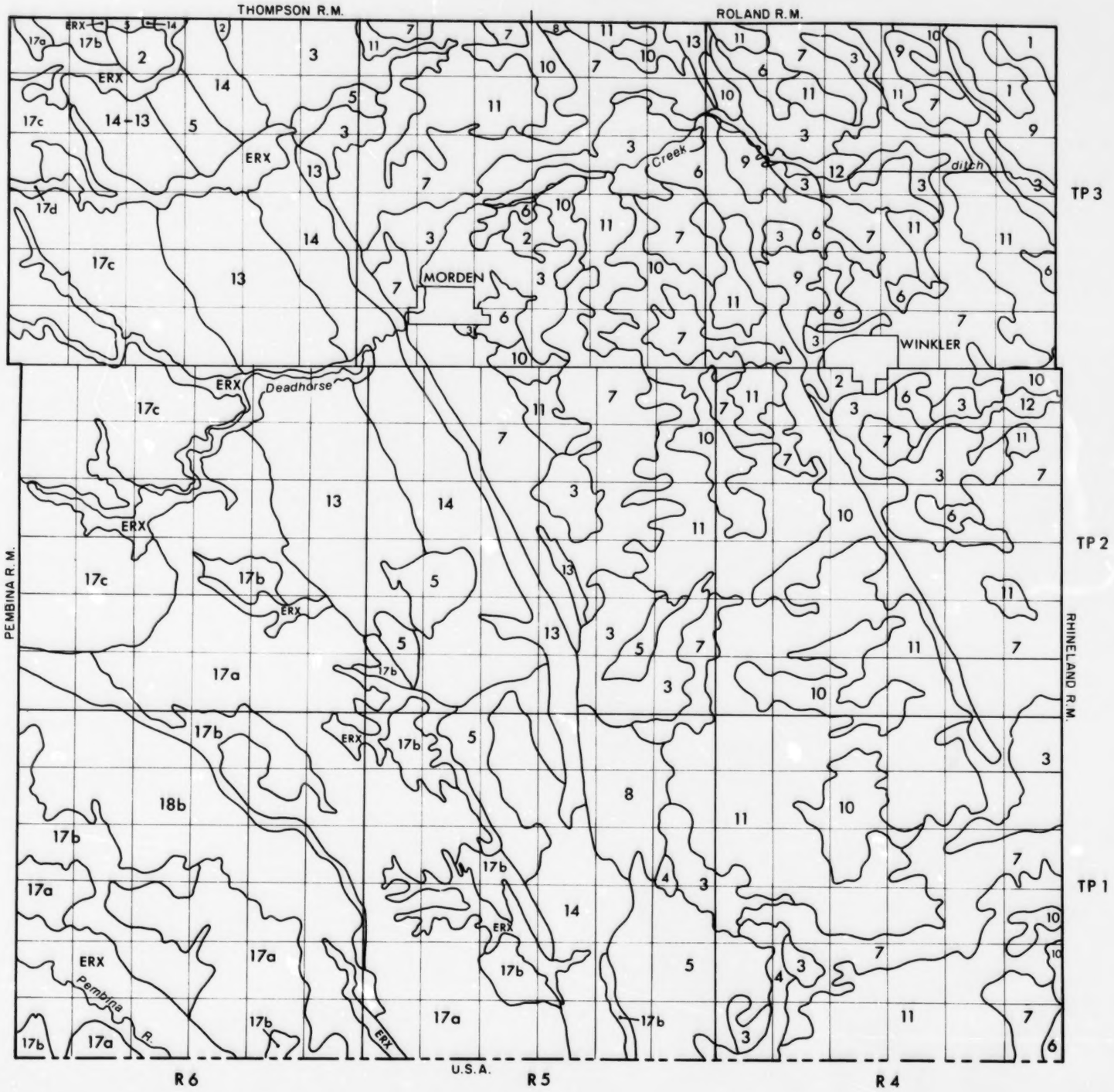
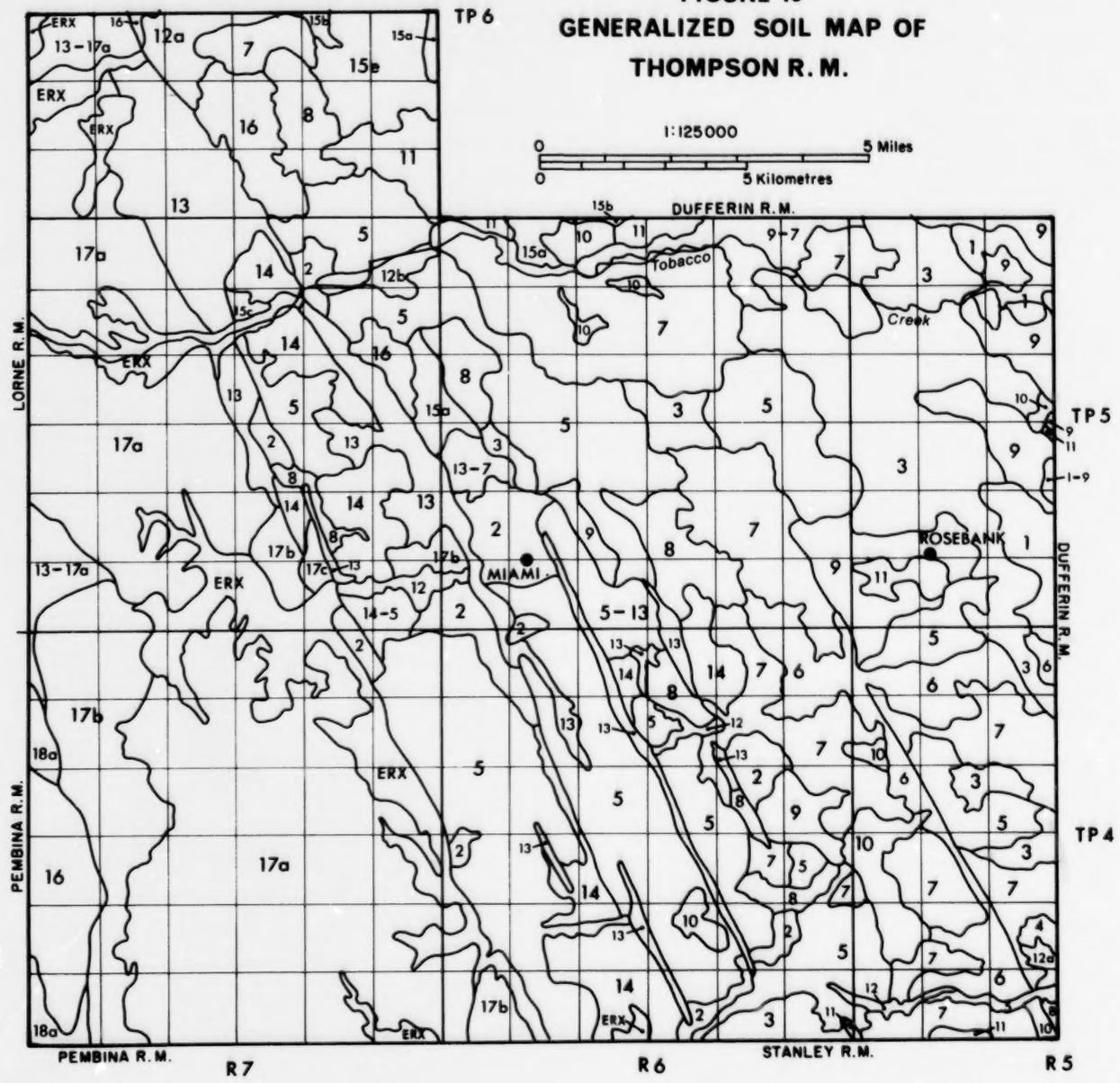


FIGURE 17
GENERALIZED SOIL MAP OF STANLEY R.M.

1:125000
0 5 Miles
0 5 Kilometres

FIGURE 18
GENERALIZED SOIL MAP OF
THOMPSON R. M.



Appendix F

INTERPRETATION OF MAP UNIT SYMBOLS AND SOIL LEGEND

The Soil Series Map Unit is identified by three alphabetic letters, e.g. DZW-Dezwood series. The phase of the series is identified by an alphabetic or numeric symbol below the soil series symbol. Four possible phases or combinations of phases are presented as follows:

a) first space, numeric, indicates degree of erosion,
b) second space, alphabetic, indicates slope class,
c) third space, numeric, indicates degree of stoniness,
d) fourth space, alphabetic, indicates degree of salinity.

x - is used to identify the absence of, or the degree of minimal erosion, slope class, stoniness and salinity permitted in the definition of the normal soil.

p - after the series name indicates the peaty phase,

1 - or other numerals after the series name indicates a variant of the normal series; it may be due to composition difference, textural difference or other property at varience from the norm.

4 - superscript numbers following the series symbol in a complex map unit refer to the percentile of that series and phase in the map unit.

Examples - Single Map Units:

ATN indicates the Altamont soil series with minimal or absent phase features.

GRRp indicates the peaty phase of the Guerra series.

ZIM/xxxs indicates the Zinman series, slightly saline phase; the erosion, slope and stoniness are minimal or normal for the series.

DGF/xx2x indicates the Darlingford series moderately stony phase.

Complex Map Units: DGF^{6}/1x1x - NKK^{4} - indicates a compound map unit consisting of 60 percent Darlingford, slightly eroded, slightly stony and 40 percent Nikkel series.

Soil Legend for Dufferin, Grey, Roland, Stanley and Thompson Municipalities

Soil Symbol	Soil Name	Surface Texture	Soil Drainage	Mode of Deposition	Family Particle Size	Subgroup
ARN	Aronet	LFS	WELL	Eolian	Sandy	CU.R
ASS	Almasippi	LFS	IMPER	Lacustrine	Sandy	GLR.BL
ASZ	Agassiz	LS	WELL	Glaciofluvial	Sandy Skeletal	O.BL
ATN	Altamont	CL	WELL	Lacustrine/Till	Fine Loamy	O.DG
BEO	Benton	C	WELL	Residual,Till/Shale	Clayey/Shale	DG.SS
BIP	Bishop	C	IMPER	Residual,Till/Shale	Clayey/Shale	GLR.BL
BKA	Birkenhead	LS	M.WELL	Fluviolacustrine	Sandy Skeletal	CA.BL
BKR	Basker	SICL	POOR	Fluvial	Loamy	R.HG
BMG	Blumengart	C	IMPER	Fluviolacustrine	Clayey	GLCU.R
BNF	Blumenfeld	L	POOR	Lacustrine	Loamy	R.HG
BNI	Brundis	C	WELL	Residual,Till/Shale	Clayey/Shale	O.BL
BUM	Blumenort	C	POOR	Fluviolacustrine	Clayey	R.HG
CAV	Carvey	CL	POOR	Lacustrine/Fluvial	Loamy/Sandy Skeletal	R.HG
CTZ	Chortitz	CL	IMPER	Fluvial	Loamy	GLCU.R
CXT	Capell	CL	IMPER	Lacustrine/Fluvial	Fine Loamy/Sandy Skeletal	GLR.BL
CYN	Croyon	L-CL	WELL	Lacustrine/Fluvial	Loamy/Sandy Skeletal	O.BL
CZK	Cazlake	CL	POOR	Till	Fine Loamy	R.HG
DGF	Darlingford	CL	WELL	Till	Fine Loamy	O.BL
DGS	Dugas	C	IMPER	Lacustrine	Clayey/Loamy	GLR.BL
DHO	Deadhorse	C	IMPER	Lacustrine	Clayey	GLR.BL
DNH	Denham	L	WELL	Lacustrine	Loamy/Clayey	O.BL
DOB	Dobbin	FS	WELL	Lacustrine	Sandy	O.DG
DXM	Druxman	L	IMPER	Lacustrine/Fluvial	Loamy/Sandy Skeletal	GL.BL
DZW	Dezwood	L	WELL	Till	Fine Loamy	O.DG
EBG	Edenburg	CL	WELL	Lacustrine	Fine Loamy/Sandy	O.BL
EDK	Edkins	L	POOR	Lacustrine	Loamy/Clayey	R.HG
EEK	Elm Creek	FSL	IMPER	Lacustrine	Sandy/Clayey	GL.BL
EGF	Eigenhof	CL	WELL	Lacustrine	Fine Loamy	O.BL
EMV	Elm River	SICL	M.WELL	Fluvial	Loamy	CU.R
ERX	Eroded Slope Complex	Var.	WELL-IMP		Variable	

Soil Legend for Dufferin, Grey, Roland, Stanley and Thompson Municipalities

Soil Symbol	Soil Name	Surface Texture	Soil Drainage	Mode of Deposition	Family Particle Size	Subgroup
FFR	Fifere	L	WELL	Till	Fine Loamy	O.DG
FRS	Ferris	CL	IMPER	Till	Fine Loamy	GLR.BL
FSO	Fresno	L	IMPER	Till	Fine Loamy	GL.DG
FTE	Fortier	SIC	IMPER	Fluvial	Clayey	GLCU.R
FWK	Froswick	CL	M.WELL	Till/Shale	Fine Loamy/Shale	O.BL
GCS	Glencross	L	IMPER	Lacustrine/Till	Fine Loamy	GLR.BL
GCS1	Glencross	L	IMPER	Lacustrine/Till/Lmsn	Fine Loamy	GLR.BL
GDH	Gnadenthal	L	IMPER	Lacustrine	Loamy	GLR.BL
GRA	Gretna	C	IMPER	Fluviolacustrine	Very Fine Clayey	GL.SZ
GRR	Guerra	CL	POOR	Lacustrine/Till	Fine Loamy	R.HG
GVS	Gervais	SICL	IMPER	Fluvial	Loamy	GLCU.R
GYV	Graysville	L	IMPER	Lacustrine	Loamy/Clayey	GLR.BL
HEB	Hebbot	CL	WELL	Till	Fine Loamy	R.BL.
HHF	Hochfeld	FSL	M.WELL	Lacustrine	Coarse Loamy	O.BL
HIN	Hibsin	FSL	M.WELL	Lacustrine	Coarse Loamy/Clayey	O.BL
HND	Horndean	C	IMPER	Lacustrine	Clayey/Loamy	GL.BL
HOS	Horose	CL	POOR	Till	Fine Loamy	R.HG
JIS	Jirose	CL	IMPER	Till/Shale	Fine Loamy/Shale	GLR.BL
JOD	Jordan	C	WELL	Lacustrine	Clayey/Loamy	O.BL
JST	Jasset	VFSL	IMPER	Lacustrine	Loamy/Sandy	GL.BL
JYL	Joyale	CL	IMPER	Lacustrine/Till	Fine Loamy	GLR.BL
KDA	Klidal	C	IMPER	Residual,Till/Shale	Clayey/Shale	GLSZ.BL
KIS	Kingsley	L	WELL	Lacustrine/Till	Fine Loamy	D.GL
KOT	Kronstal	LVFS	IMPER	Lacustrine	Coarse Loamy	GL.BL
KUD	Knudson	CL	WELL	Lacustrine/Till	Fine Loamy	O.BL
LAY	Layland		POOR	Lacustrine	Sandy	R.HG
LEI	Levine	SICL	IMPER	Fluvial	Loamy	GLCU.R
LEW	Loewen	CL	POOR	Fluvial	Loamy	R.HG
LLT	Lelant	FSL	POOR	Lacustrine	Sandy	R.HG
LOP	Long Plain	LFS	IMPER	Lacustrine	Sandy	GL.R

Soil Legend for Dufferin, Grey, Roland, Stanley and Thompson Municipalities

Soil Symbol	Soil Name	Surface Texture	Soil Drainage	Mode of Deposition	Family Particle Size	Subgroup
LRY	Leary	LS	WELL	Glaciofluvial	Sandy Skeletal	O.DG
LSL	La Salle	SICL	M.WELL	Fluvial	Loamy	CU.R
MFI	Mansfield	LS	IMPER	Fluvial	Sandy Skeletal	GLR.BL
MHC	Marsh Complex	Peat	V.POOR	Organic	Textural Complex	R.G
MOW	Mowbray	SICL	WELL	Fluvial	Loamy	CU.R.
MRH	Marringhurst	LS	WELL	Fluvial	Sandy Skeletal	CA.BL
MRS	Morris	C	IMPER	Lacustrine	Clayey	GLSZ.BL
MXS	Manitou	CL	WELL	Till	Fine Loamy	O.BL
NBG	Neuenberg	VFSL	IMPER	Lacustrine	Loamy/Sandy	GLR.BL
NKK	Nikkel	CL	IMPER	Till	Fine Loamy	GL.BL
NOW	Nowell	CL	IMPER	Till	Fine Loamy	GL.BL
NTO	Nanton	L	IMPER	Lacustrine/Till	Loamy	GL.BL
NUH	Neuhorst	CL	IMPER	Lacustrine	Fine Loamy	GLR.BL
NWN	Newton Siding	CL	IMPER	Lacustrine	Fine Loamy/Sandy	GLR.BL
OAY	Oakley	CL	WELL	Till/Shale	Fine Loamy/Shale	O.DG
OBO	Osborne	C	POOR	Lacustrine	Clayey	R.HG
OWK	Osterwick	FSL	POOR	Lacustrine	Coarse Loamy	R.HG
PBI	Pembina	CL	WELL	Till	Fine Loamy	O.DG
PER	Perillo	Peat	V.POOR	Organic/Lacustrine	Organic/Loamy	T.M
PGK	Pigeon Lake	SICL	IMPER	Fluvial	Loamy/Clayey	GLCU.R
PME	Plum Coulee	C	IMPER	Lacustrine	Clayey	GL.BL
POU	Pouchal	CL	POOR	Till	Clayey/Loamy	R.HG
PYR	Poyser	CL	WELL	Till	Fine Loamy	O.GL
RBK	Rosebank	FSL	IMPER	Lacustrine	Sandy/Clayey	GLR.BL
RFD	Reinfeld	L	M.WELL	Lacustrine	Loamy	O.BL
RGD	Rignold	L	IMPER	Lacustrine	Loamy/Clayey	GL.BL
RIV	Red River	C	IMPER	Lacustrine	Clayey	GLR.BL
RLD	Reinland	FSL	IMPER	Lacustrine	Coarse Loamy	GLR.BL
RSG	Rosengart	FSL	M.WELL	Lacustrine	Coarse Loamy	O.BL
RSI	Roseisle	L	M.WELL	Lacustrine/Till	Loamy	O.BL

Soil Legend for Dufferin, Grey, Roland, Stanley and Thompson Municipalities

Soil Symbol	Soil Name	Surface Texture	Soil Drainage	Mode of Deposition	Family Particle Size	Subgroup
RWL	Rathwell	CL	IMPER	Lacustrine	Fine Loamy	GL.BL
SCK	Stockton	LFS	WELL	Lacustrine	Sandy	O.BL
SKL	Skelding	FS	WELL		Sandy	O.R
SQR	Squirrel Creek	SIL	IMPER	Lacustrine	Loamy/Clayey	GLR.BL
SUE	St.Claude	SIL	IMPER	Lacustrine	Loamy/Sandy	GLR.BL
SXG	Stallar	L	WELL	Residual,Till/Shale	Loamy	O.R
TLI	Tellier	CL	IMPER	Lacustrine/Till	Fine Loamy	GL.DG
TNT	Trinton	L	WELL	Lacustrine/Fluvial	Coarse Loamy/Sandy Skeletal	D.GL
ULH	Ullrich	CL	IMPER	Lacustrine/Till	Fine Loamy	GL.BL
VDL	Vandal	L	WELL	Lacustrine/Fluvial	Coarse Loamy/Sandy Skeletal	O.DG
VTL	Vartel	L	IMPER	Lacustrine/Fluvial	Loamy/Sandy Skeletal	GL.DG
WIK	Winkler	C	WELL	Lacustrine	Clayey	O.BL
WIK2	Winkler Variant	C	WELL	Fluviolacustrine	Very Fine Clayey	O.BL
WOR	Worden	CL	WELL	Till	Fine Loamy	O.R
WWB	Willowbend	L	POOR	Fluvial	Loamy	R.HG
WWC	Willowcrest	LFS	IMPER	Lacustrine	Sandy	GL.BL
XVI	Xavier	Peat	V.POOR	Organic	Mesic Peat	TY.M
YTK	Yustak	L	POOR	Lacustrine/Fluvial	Coarse Loamy/Sandy Skeletal	R.HG
ZIM	Zinman	C	IMPER	Lacustrine/Till	Clayey/Loamy	GLSZ.DG
ZPI	Zaplin	CL	IMPER	Till	Fine Loamy	GL.DG

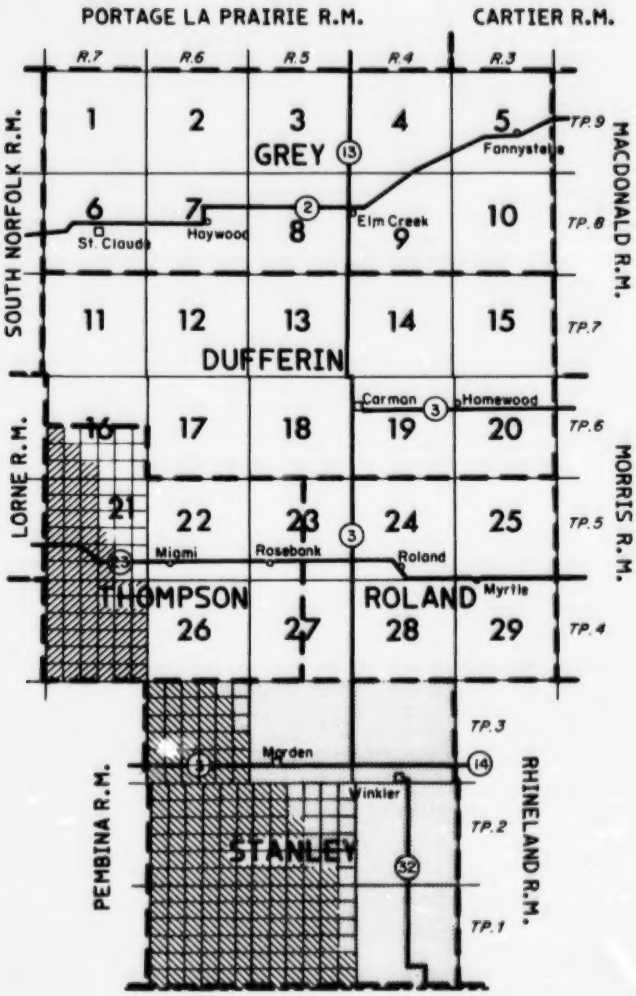


Figure 19: Index to Map Sheet.

MAPS
NOT
FILMED

CARTES
OMISES